ERRATA.

Page 18, line 3, *for* percentages *read* numbers.

Page 19, line 7, *for* allgermein *read* allgemein.

Page 24, Footnote, *for* 1888 *read* 1884.

Page 41, Footnote, *for* total amount *read* total number.

Page 44, Second line of Section 4, *for* page 36 *read* page 41.

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Vaccination and the Act of 1898. *By* Arthur Francis Burridge, *Actuary and Secretary of the Equity and Law Life Assurance Society, and a Vice-President of the Institute of Actuaries.*

[Read before the Institute, 28 April 1902.]

I.—Historical.

Our *Journal* contains singularly little information on Vaccination—a brief remark by S. H. Ward, M.D., in 1860 (*J.I.A.*, viii, 339); some paragraphs in a general paper by H. W. Porter, in the same year (*J.I.A.*, ix, 151); and a paper by Dr. Sprague in 1877 (*J.I.A.*, xx, 216), are the only references to the subject that I have been able to trace.

Dr. Sprague asked the question, "Does vaccination afford any protection against small-pox"? He examined the statistics put forward by medical men in support of vaccination, and also gave a full account of a report by Dr. Keller, an opponent of vaccination, on the sickness from small-pox among the employees of the Austrian State Railway Company in the year 1873.

Although Dr. Sprague had no reason to doubt the trustworthy character of Keller's statistics, yet he arrived at the conclusion that the figures did not justify Keller's inference that vaccination had proved useless.

A strong light has been more recently thrown upon Keller's statistics in a work by Herr Kőrösi, Director of the Municipal Statistical Bureau of Buda Pesth, and Honorary Fellow of the

Royal Statistical Society.* This book was brought to my notice by Dr. E. J. Edwardes, a well-known writer on vaccination, author of "Vaccination and Small-pox."† Dr. Edwardes, dealing with Keller's figures, writes as follows:—

"..... the sanitary medical men of Vienna, the "Stadtphysicat, went over the very same ground as Keller, and "brought out quite opposite results, *i.e.*, they found that the "evidence told strongly in favour of vaccination. Again, Keller's "results are not based on sound statistical principles, for he "deduces percentages of deaths from one actual death, or two or "three deaths—a ridiculous procedure, which has been aptly "called by the anti-vaccinists themselves the 'percentage "swindle.'

"But worse remains behind. Herr Kőrösi, in 1887, went "over the whole ground again, and found that *Keller directly "falsified the returns* originally supplied to him by the Railway "surgeons. Kőrösi obtained from eight surgeons copies of their "original returns; *all eight had been altered by Keller* so as to "tell against vaccination. Keller's bias was well known in "Vienna.

"Dr. Pichler, of Steiersdorf, had fortunately sent a copy of "his return in 1873 to the Comitätsbehörde of Lugos; in his "case Keller had altered the figures '68' to '38.' At "the International Medical Congress in Washington, 1887, "a Special Committee was appointed to examine and report on "Keller's statistics. The Committee reported—and the "signatures include that of Dr. A. B. Arnold, President of "the Section of General Medicine—that all the returns "submitted to them were without exception falsified in such "a manner as to raise the mortality from small-pox amongst "the vaccinated, while that of the unvaccinated was lessened."

I have referred to Herr Kőrösi's book, and verified Dr. Edwardes' quotations therefrom. In the debate on Compulsory Vaccination in the House of Commons, on 13 May 1893, Sir Walter Foster, M.P. (then Parliamentary Secretary of the Local Government Board) called attention to Kőrösi's exposure of Keller and to the Report of the Special Committee.

* Kritik der Vaccinations—Statistik und Neue Beiträge zur Frage des Impfschutzes. Josef Kőrösi: Berlin, 1889.

† Vaccination and Small-pox. E. J. Edwardes, M.D. Lond. J. and A. Churchill, 1892.

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History of Vaccination. As it would appear desirable that some account of the history of vaccination should be found in the *Journal*, I have recorded the main facts as follows :—

Notes on Early History of Vaccination and Legislation.

Inoculation for Small-pox. The practice of inoculation for small-pox, that is, the artificial introduction of the virus into the system by the insertion of fluid from a variolous pustule into wounds of the skin made for the purpose, was first definitely brought to general notice in England by a letter from Lady Mary Wortley Montagu, in 1717. It had long been practised in Turkey and other Eastern countries, and its utility was well known, before its introduction into England, both in the south of Wales and in the Highlands ; but the first clearly recorded case in England is that of the daughter of Lady Mary Wortley Montagu (whose son had some time before been inoculated at Constantinople), inoculated by Maitland in London, in April 1721. It was very slowly adopted in this country, and it was not until it had been practised on six criminals (whose liberty was promised to them if they recovered, which they fortunately did) that it was generally received.

In 1746 an Inoculation and Small-pox Hospital was started in London, and in the latter half of the eighteenth century the practice of inoculation seems to have been very general, more especially among the more wealthy, though the incidence of the inoculated varied largely in different localities.

3 and 4 Vict. c. 29. After the introduction of vaccination, the practice of inoculation fell into disuse, and was rendered a penal offence by the first Vaccination Act, in 1840.

Vaccination. That infection with cow-pox would give immunity from small-pox had been a popular belief among country people long before the apprenticeship of Jenner; by the medical profession, however, the belief was either ignored or looked upon as a popular error.

The idea that it might be possible to propagate the cow-pox, and with it the security from small-pox, first appears to have struck Jenner about the beginning of the last quarter of the eighteenth century, but it was not until 1796 that he made his first decisive experiment. On the 14 May 1796, a boy named Phipps, eight years of age, was successfully vaccinated with

lymph taken from the hand of a dairymaid, who had been infected with the disease by milking cows suffering from cow-pox. On the following 1 July, Phipps was subjected to what is known as the "variolous test", that is to say, he was inoculated for small-pox without sensible effect, and was thus shown to be insusceptible to small-pox. Some months afterwards the boy was again inoculated, as before, without effect.

As the result of this and other similar experiments, Jenner published in 1798 his first memoir, "An Inquiry into the causes and effects of the Variolæ Vaccinæ."

In January 1799, cow-pox was discovered in a dairy in the Gray's Inn Lane, and became the subject of experiments on a large scale by Dr. Woodville and Dr. Pearson at the Small-pox Hospital. Seven persons at the hospital were originally vaccinated with matter taken direct from one of the Gray's Inn Lane cows, and others from that taken from the hands of a dairymaid.

From these cases was established the stock distributed at home and abroad, and known as "Woodville's lymph"; this, also, was the beginning of the more general practice of vaccination, since Jenner's original stock had come to an end. But although Jenner received supplies of Woodville's lymph for his own use and for purposes of distribution, he also obtained and distributed lymph obtained from other sources—notably from a farm in Kentish Town. In July 1800, 33 of the most eminent physicians and 40 distinguished surgeons of London signed a declaration of adhesion to the new doctrine.

In 1802, a Committee of the House of Commons, after gathering evidence from experienced witnesses, reported that vaccine inoculation was preventive in its effect, and introduced a milder disorder than inoculated small-pox, which was not capable of being communicated by contagion.

In 1807, the Royal College of Physicians presented a report to the House of Commons, the result of an extensive enquiry, to a similar effect; as an outcome of their enquiry the College strongly recommended the practice of vaccination. In this year was founded, by Royal Warrant, the National Vaccine Establishment. The data for determining to what extent vaccination was practised in the first quarter of the 19th century are too uncertain to allow of any value being attached to the result; it is certain, however, that the amount was very considerable, as such isolated records as the following show:—Of over 8,000 children under

12 years of age admitted into the Royal Metropolitan Infirmary between October 1820 and April 1822, 41 per-cent had been vaccinated and 6 per-cent inoculated.

In 1824, of 8,112 inhabitants of Cambridge, who had been born since the introduction of vaccination, 48·7 per-cent had been vaccinated.

The year 1837 is of interest, as in that year the present system of registration of deaths commenced in England, so that more exact statistics of mortality from small-pox are thereafter available.

3 and 4 Vict. c. 29.

Prior to the Victorian era no statute was passed dealing with the matter of vaccination. The year 1840 is the starting-point of vaccination legislation; on the 23 July of that year was passed "An Act to extend the practice of Vaccination." This Act, by directing the Guardians and Overseers of every parish in England and Wales to contract with their medical officers for the vaccination of all persons resident in such parishes, provided for the extension of gratuitous vaccination to persons of every class.

Inoculation of the small-pox was declared by the Act to be an offence liable to summary conviction.

The Poor Law Commissioners were empowered to carry the Act of 1840 into operation. Reporting in August 1841, they state that of the 583 Boards of Guardians in England and Wales, 533 had entered into vaccination contracts up to the end of April. Some of the unions had delayed taking these steps from a feeling of misapprehension, as to whether the Act authorized the payment of the vaccinators out of the poor rate; and, in some cases, it had been erroneously considered that the acceptance of the benefit provided by the Legislature would deprive the person whose child might thus be vaccinated of the parliamentary franchise (the Act of 1841 described below was intended to remove these doubts).

The Commissioners thus describe the arrangements for vaccination in the various unions:—

"The union is divided into districts, and in each district vaccination stations have been appointed, so numerous and near to each other that few persons will have to walk more than two miles to the station, and ordinarily the distance will be much less. The vaccinator for the district attends at each station periodically on a fixed day and hour, and attends at the same station on the eighth

day (the day week) afterwards, to inspect the cases which he has vaccinated at such first attendance; and, having ascertained the result of the vaccination, gives to the party, if it be successful, a certificate to that effect."

4 and 5 Vict. c. 24. On 21 June 1841, was passed "An Act to amend an Act to extend the practice of Vaccination."

The Act provided that the expenses incident to the execution of the Act of 1840 were to be paid out of the rates. It further declared that persons vaccinated under the Act should not be considered to be in receipt of parochial relief, or be, on account of such vaccination, deprived of any privilege or subject to any disability. It will be seen that by these Acts of 1840 and 1841, vaccination was entirely voluntary; no compulsion was brought to bear on parents or others. Further, as the amount of the remuneration to be received was to depend on the number of persons who, *not having been previously successfully vaccinated*, shall be successfully vaccinated, it would appear that revaccination was not contemplated.

16 and 17 Vict. c. 100. By the Act of 20 August 1853, "An Act further "to extend and make compulsory the Practice of "Vaccination", infant vaccination was first made compulsory in England and Wales. The parents of every child born after 1 August 1853, were required, under a penalty not exceeding 20*s*., to present such child for vaccination within three months of birth.

The Public Vaccinator was empowered:—

(1) To postpone the vaccination if the child were not in a fit state.

(2) To give a certificate of insusceptibility if he was of opinion that a child vaccinated by him was insusceptible of the vaccine disease.

24 and 25 Vict. c. 59. The Vaccination Amendment Act, 1861, empowered the Guardians or Overseers to appoint persons to compel obedience to and enforce penalties imposed upon defaulters by the previous Acts.

30 and 31 Vict. c. 84. On the 12 August 1867, was passed "An Act to "consolidate and amend the laws relating to "Vaccination."

The Act, which came into force as from 1 January 1868,

practically continued the provisions of the previous Acts, at the same time providing for details of organization. Revaccination was specifically encouraged and paid for at the rate of two-thirds of that for primary vaccination.

34 and 35 Vict. c. 98. This was an Act passed 21 August 1871, entitled "An Act to amend the Vaccination Act of 1867." In the meantime a Select Committee had been appointed to enquire into the working of the 1867 Act, and the Act of 1871 was introduced by its chairman. The principal alteration in the existing law effected by the Act was that, whereas under the principal Act the appointment of an officer to enforce its provisions was optional, it was now made obligatory.

Since 1871, the superintendence and direction of the work of vaccination has been carried on by the Local Government Board.

By Royal Warrant, bearing date 29 May 1889, a Royal Commission was appointed to enquire into the whole subject of vaccination, and its beneficial or injurious effect, and as to the advisability of making alterations in the then existing Legislature and its enforcement.

The enquiry of the Commission extended over several years. They held 136 meetings, and examined 187 witnesses, and caused several important investigations to be conducted for their assistance. Their final Report was dated August 1896, two of the Commissioners dissenting therefrom.

61 and 62 Vict. c. 49. The Act that followed was confessedly of a somewhat tentative character, framed with the object of removing, as far as possible, the objections of those opposed to compulsory vaccination.

Its provisions include :—

1. The extension of the period for primary vaccination to six months from birth.

2. The exemption from the penalty for non-vaccination, if the parent, within four months of the birth of the child, satisfies two justices, or a stipendiary or metropolitan police magistrate, that he conscientiously believes that the vaccination would be prejudicial to the health of the child.

3. The limitation in case of non-compliance with the Act to one conviction and penalty for the same offence;

and the treatment of the person so convicted as a first-class misdemeanant.

4. An extension of the powers vested in the Local Government Board.

The passing of this Act closed, temporarily at all events, the period of compulsory vaccination which had existed since 1853.

Chronological Table of Vaccination Legislation in various Countries.

In the following statement is shown the general trend of legislation in this country consequent upon the abolition of inoculation in 1840, and of legislation in some of the Colonies, and in foreign countries:—

Countries in which Vaccination is enforced by legislation.

Name of Country.	Voluntary gratuitous Vaccination introduced.	Vaccination of Infants made compulsory [A]; efficiently carried out [B]; modified in [C]	Gratuitous Revaccination introduced.	Revaccination made compulsory.
England and Wales	1840	[A] 1853 [B] 1871 [C] 1898	1867	...
Scotland	1848	[A] 1863	...	...
Ireland	1840	[A] 1863	1878	...
Sweden	...	[A] 1816	...	[Army] 1849
Prussia	...	[Army only] 1834 [A] 1874	...	1874
Italy	...	[A] 1888	...	[School age] 1888
Denmark	...	[On admission to school and to confirmation] 1810 [A] 1871	...	...
* The Netherlands	...	[On admission to school] 1873	...	...
Roumania	...	...	...	1893
Hungary	...	...	...	1887
Württemburg	...	1818	...	...
Schleswig & Holstein	...	[On admission to school and confirmation] 1811	...	...
Norway	...	[A] 1811	...	...
Bavaria [first in Europe]	...	[A] 1807	...	...
Kurhessen [Hesse]	...	[A] 1815	...	...
Nassau	...	[A] 1818	...	...
Hanover	...	[A] 1821	...	...
Baden	...	[A] 1815	...	...

* Note.—For some of the dates in the second section of this table, I am indebted to Dr. Edwardes.

Countries not enforcing Compulsory Vaccination by Legislation.

Switzerland. Five Cantons in 1895 abolished compulsory vaccination, namely, Bern, Solothurn, Graubunden, Aargau, and Heuenberg. Five Cantons in 1883 abolished compulsory vaccination, namely, Zurich, Lucerne, Basle (City)* 1882, St. Gallen, and Thurgau.

* In the year 1885, the mortality from small-pox in Basle was 105·6 per 100,000 population.

Belgium. No law yet.

Russia. Orders exist, but no organized system.

Austria. Vaccination and revaccination, 1886; compulsory in Army.

France. Vaccination before admission to school, compulsory by regulations; thorough vaccination began in 1888.

Spain. Orders exist, but no organized system.

Notes on Colonial Legislation.

New South Wales. Small-pox is practically unknown in New South Wales, there not having been any deaths from it in 1899, and only three during the last ten years. Vaccination is not compulsory, and is only resorted to in times of scare. It is easy to discover from the returns of the Government vaccinators the years when the community was threatened by the disease, as at such times the number of persons submitting themselves to vaccination largely increased.

Victoria. Parents are required by law to have their children vaccinated. Only 26 deaths from small-pox have occurred since 1853, and none in the last 13 years.

Queensland. Vaccination is regulated by Public Health Act, 1900, which provides that the Commissioner, with the approval of the Governor, may appoint a place or places for the performance of vaccination in any area in which the provisions of the Act are in force.

In any such area, compulsory vaccination within six months of birth is enforced under a penalty not exceeding £5, unless the parent makes a Statutory declaration of conscientious objection.

Western Australia. Vaccination is compulsory. Small-pox is practically unknown in the State, only one outbreak having recently occurred, and that was rapidly stamped out.

Tasmania. Vaccination Act, 1898:—Every medical practitioner shall, unless he objects, be appointed a vaccinator, who shall vaccinate gratuitously all children and others applying to him.

Every child to be vaccinated within 12 months of birth. In default, parent liable to penalty not exceeding £5 unless he forwards to Registrar a statutory declaration, made before a Justice of the Peace, that he conscientiously believes that vaccination will be permanently detrimental to the health of the child.

Medical practitioners can obtain a supply of calf lymph on application to the Secretary of the Central Board of Health.

New Zealand. Vaccination is now regulated by Public Health Act, 1900, which provides for compulsory vaccination within one year of birth, under penalty of 40*s.* to parent, unless he can give a statutory declaration of conscientious objection.

Canada. Vaccination is dealt with by Provincial legislation in the Dominion, and, consequently, the Boards of Health in the different Provinces are responsible for the regulations appertaining to it.

Cape of Good Hope. Vaccination is regulated by Public Health Act, 1897, which requires vaccination to take place within three months of the birth of a child. No conscience clause.

Natal. Vaccination compulsory. No conscience clause.

Comparative influence of Small-pox on total mortality for London in the last two centuries. Before attempting to analyze the influence of vaccination in this and other countries, it may be well to trace, in a general manner, the relative influence of small-pox on the rate of mortality.

In the absence of trustworthy data of populations, this can be best done by a comparison of the deaths from small-pox with those occurring from all causes. The best available source of information for this purpose in found in the Bills of Mortality for London.

While the lessening influence of small-pox on the general mortality is so marked as to be unmistakable, yet too much weight should not be attached to a comparison of this nature into which two variable factors enter, namely, the small-pox deaths, and the deaths from all causes.

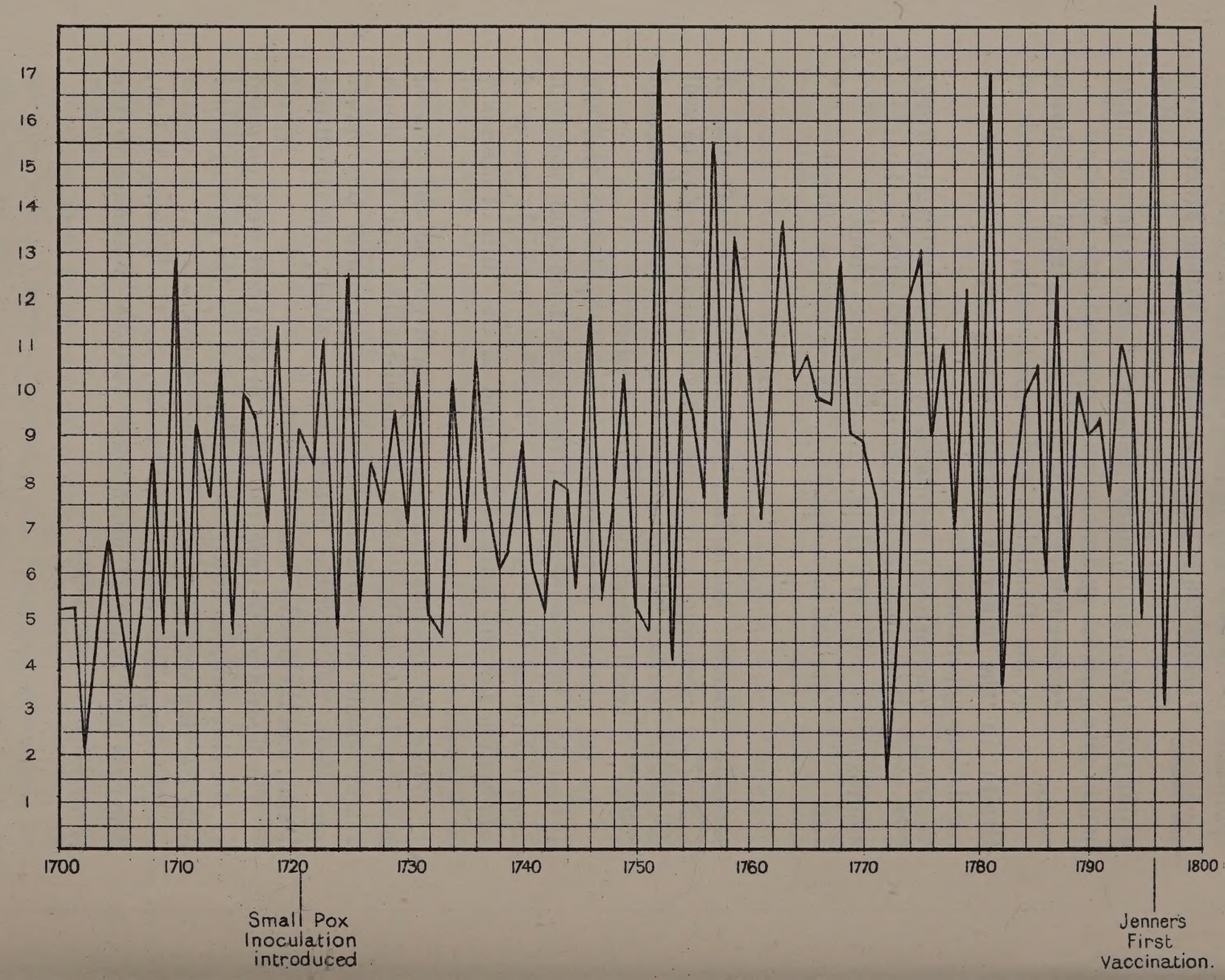
The figures which form the basis of the curve were prepared by Dr. Guy down to 1881,* and completed by the present writer from the Registrar-General's Annual Returns.

The diagrams were drawn by Mr. A. C. Thorne, F.I.A., who has also rendered much other valuable assistance in the preparation of this paper.

* Two Hundred and Fifty Years of Small-pox in London. (*J.R.S.S.*, xlv, 399).

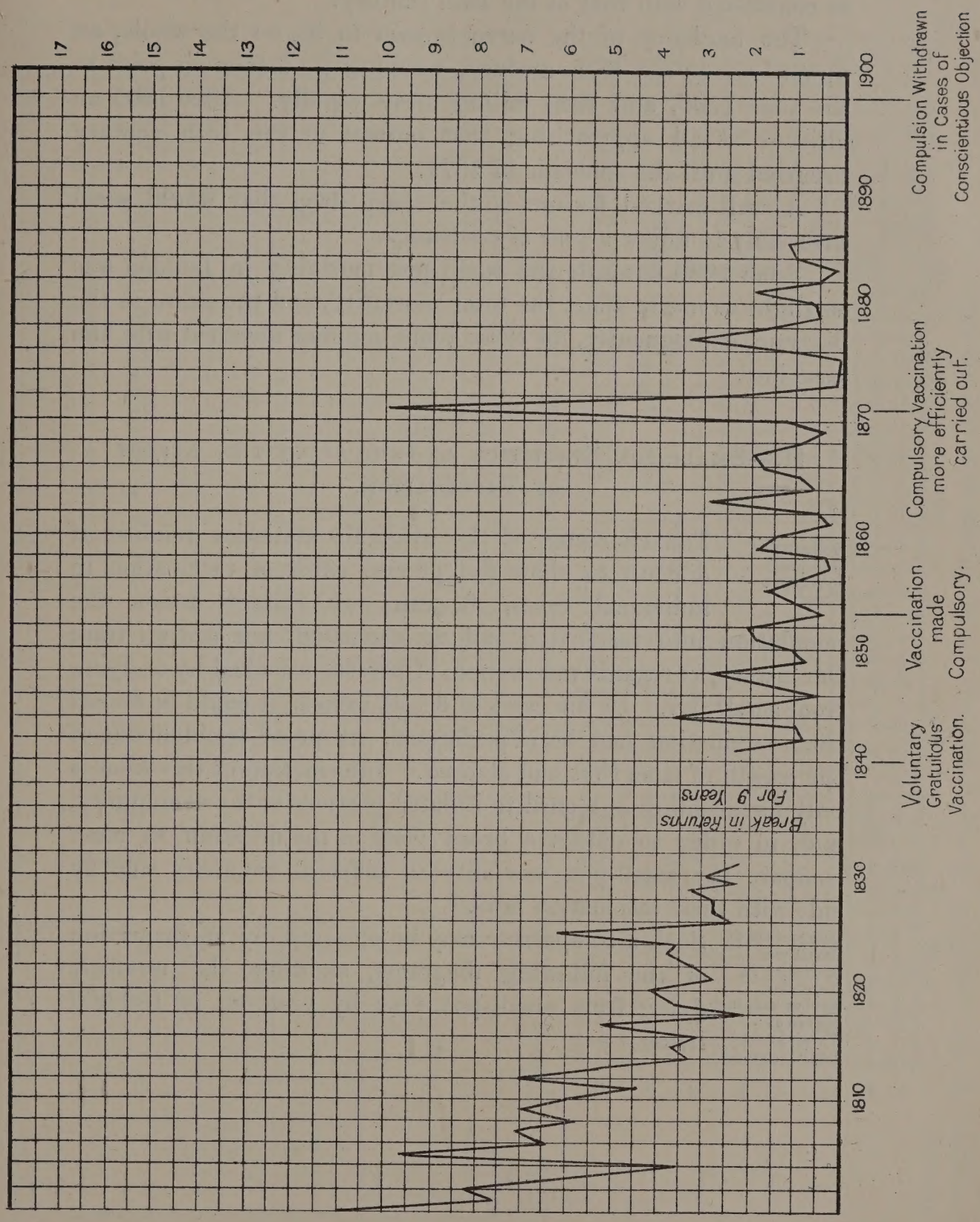
Diagram 1.

PERCENTAGE OF DEATHS FROM SMALLPOX TO DEATHS FROM ALL CAUSES IN LONDON FROM 1700 TO 1800.



Continued below.

PERCENTAGE OF DEATHS FROM SMALLPOX TO DEATHS FROM ALL CAUSES IN LONDON FROM 1800 TO 1900.



Continued from above

Consideration of the curve shows, in a very marked way, the reduced weight of small-pox in the general mortality in the 19th, as contrasted with that in the 18th century.

The tendency of the curve is seen to be, on the whole, an upward one in the 18th century, reaching its maximum point in the year 1796, and then falling away rapidly. After 1805 no altitude at all approaching that normal in the 18th century occurred until the epidemic of 1871.

A well-marked feature is the sharp drop that would seem invariably to follow a year of epidemic.

From 1886 onwards the small-pox mortality in London was so slight as not to affect the total mortality, and the curve in the diagram, consequently, for these years becomes identical with the base line.

II.—Small-pox Statistics as Indicating the Effect of Vaccination.

Difficulty of obtaining conclusive Proof.

The character of the available statistics renders it difficult to show the precise effect of vaccination in individual cases, because we cannot divide the population into vaccinated and unvaccinated, nor can we trace the history, as regards vaccination, of persons attacked by or dying from small-pox. In the cases of death, even if it could be traced that vaccination had been performed, no proof is obtainable of the length of time that had elapsed. Information of this kind is only forthcoming in regard to isolated portions of the community, and, in order to obtain a broad view of the question, we must compare the small-pox mortality in different countries side by side with their vaccination laws.

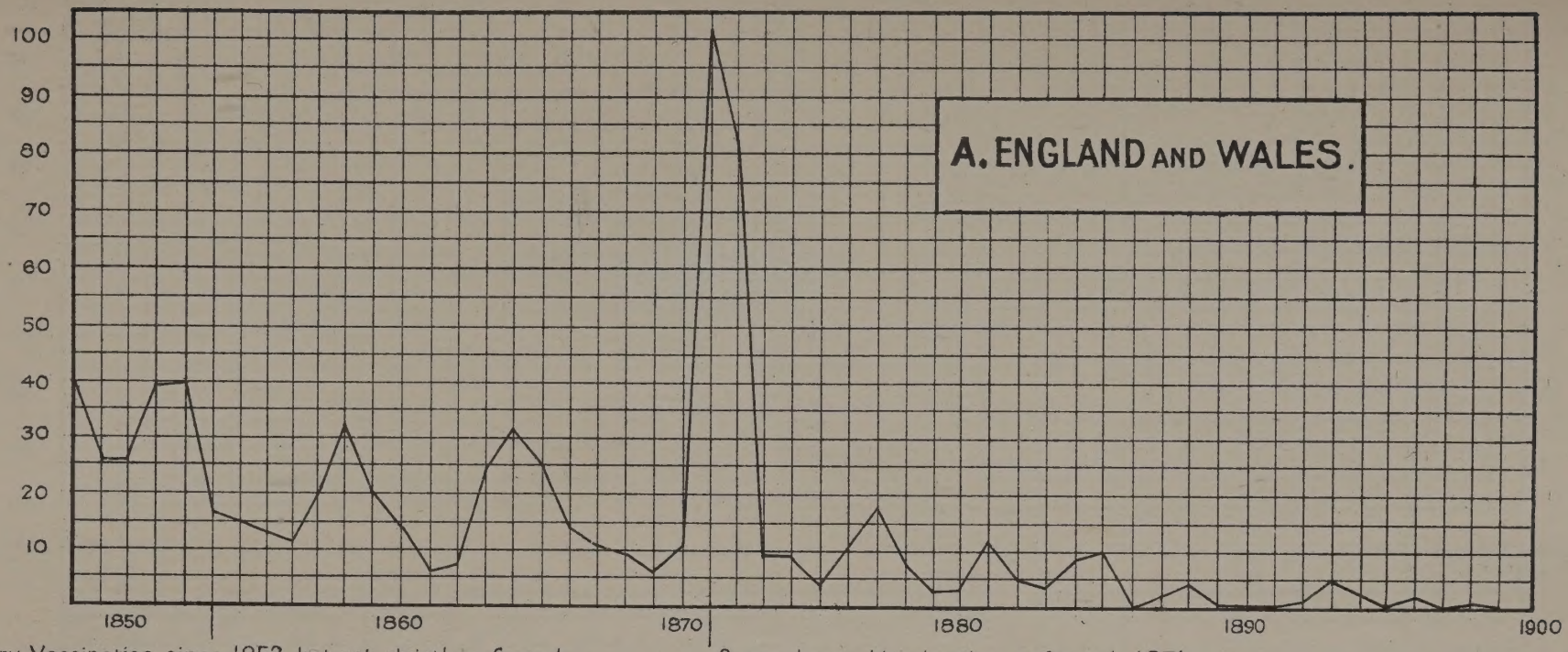
Comparison of Small-pox Mortality in Countries having varying degree of Vaccination Legislation.

Such a comparison may be obtained by an inspection of the following diagrams, showing the numbers dying from small-pox year by year out of 100,000 living:—

Diagram II.

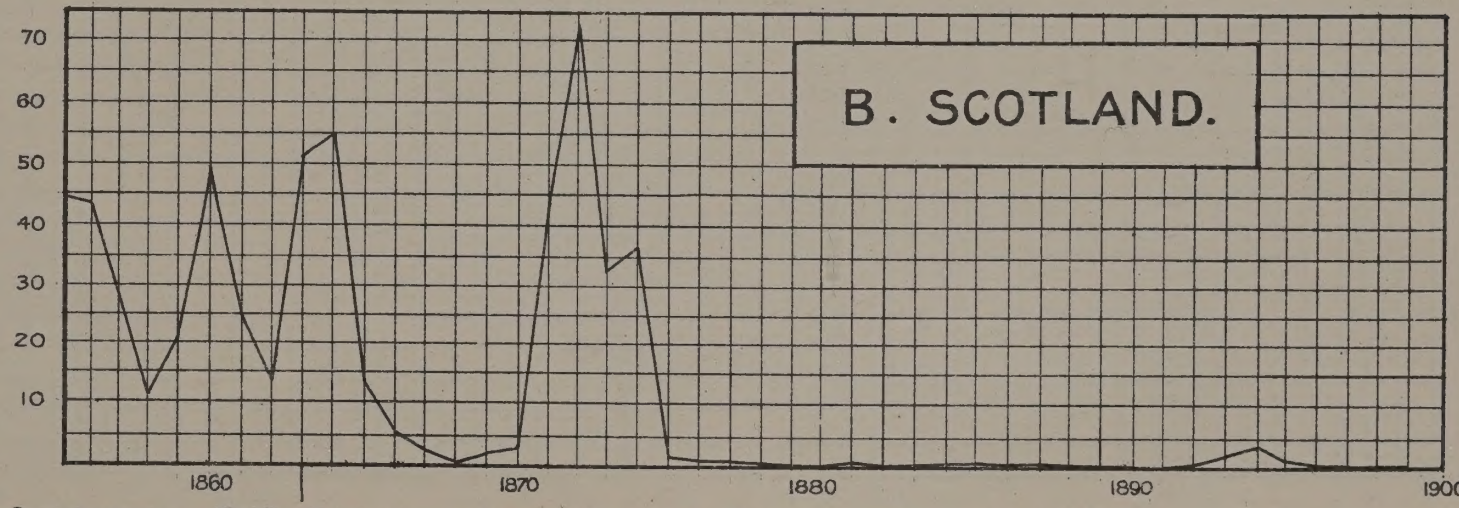
NUMBERS DYING FROM SMALL-POX OUT OF 100,000 LIVING.

COUNTRIES IN WHICH VACCINATION IS COMPULSORY.



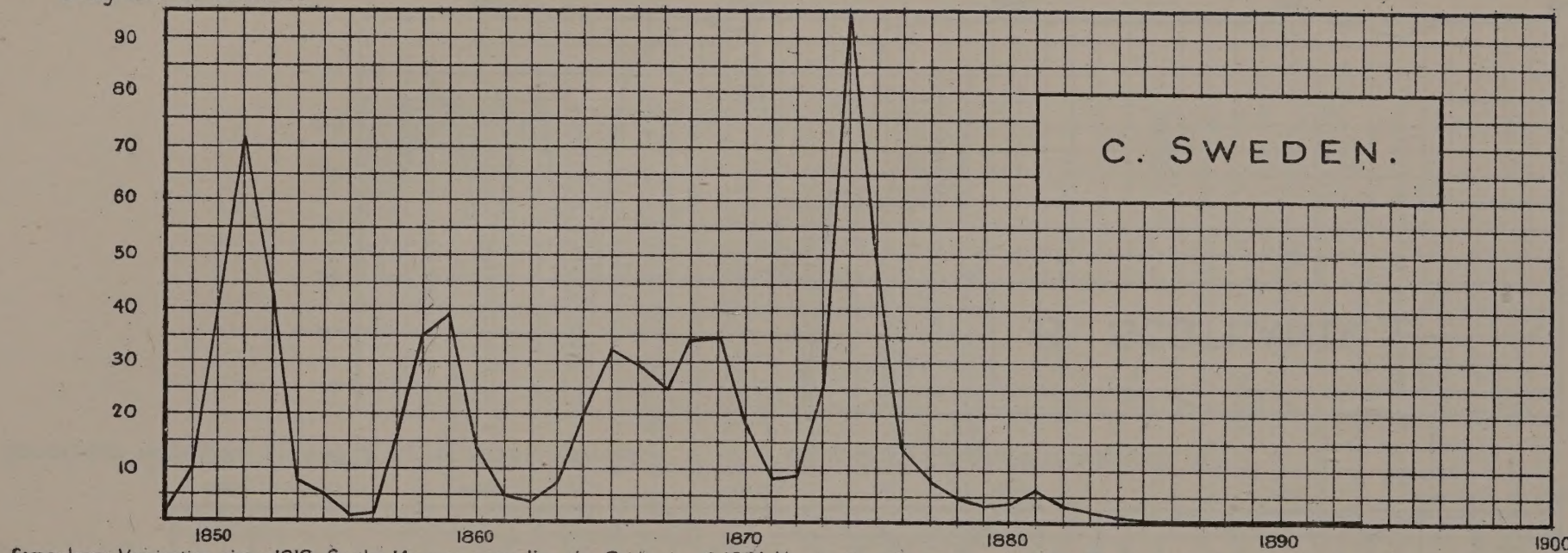
Compulsory Vaccination since 1853 but not strictly enforced.

Compulsory Vaccination enforced 1871.

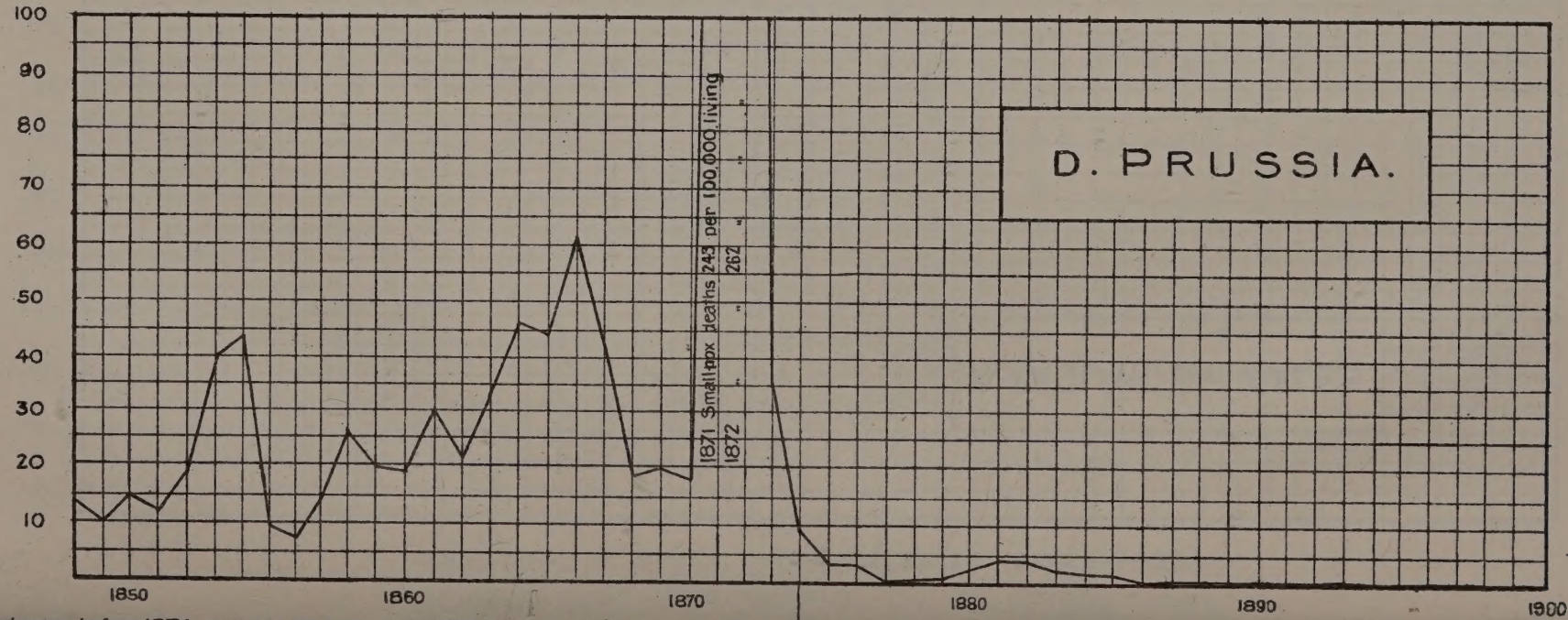


{Voluntary Gratuitous
{Vaccination in certain Parishes since 1848. Vaccination made compulsory and efficiently carried out since 1863.

Diagram II continued

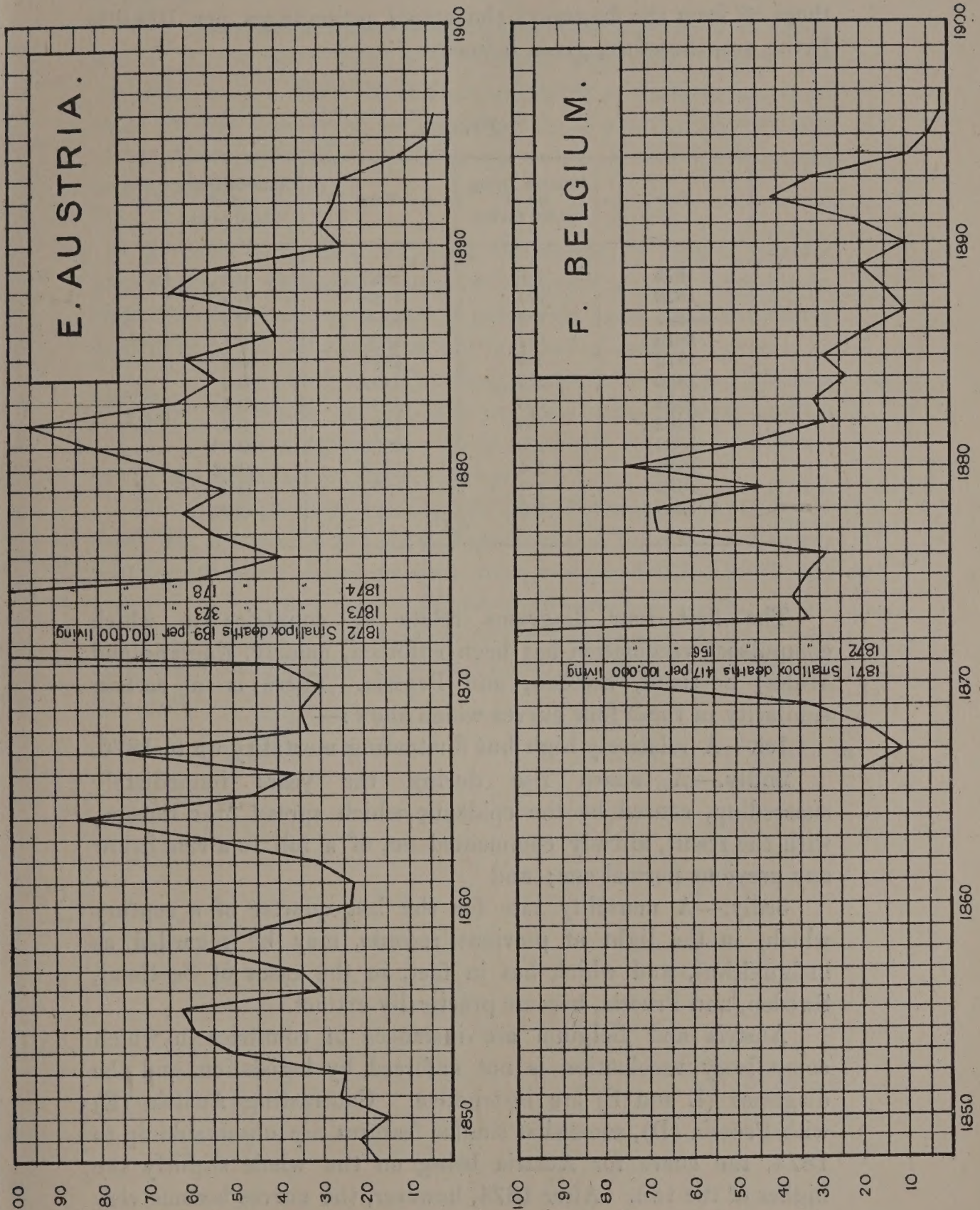


Compulsory Vaccination since 1816: for the 14 years preceding the Epidemic of 1874 Vaccinations had averaged about 75 per cent of the births. Vaccinations more strictly enforced since.



No compulsory Vaccination before 1874, except in the Army since 1834 & in Public Schools since 1871

Compulsory Vaccination and Revaccination since 1874


E. AUSTRIA.
1872 Smallpox deaths 189 per 100.000 living
1873 " " 323 " " "
1874 " " 178 " " "
F. BELGIUM.
1871 Smallpox deaths 417 per 100.000 living
1872 " " 156 " " "
100
90
80
70
60
50
40
30
20
10
1850
1860
1870
1880
1890
1900

B

In the case of Prussia the percentage of those dying from small-pox since 1874 are so small that it becomes difficult to read them off from the diagram; the actual percentages per 100,000 living are, therefore, given below:—

Prussia.

Year	Number Dying out of 100,000 Living	Year	Number Dying out of 100,000 Living
1875	3·6	1887	0·5
1876	3·1	1888	0·3
1877	0·3	1889	0·5
1878	0·7	1890	0·1
1879	1·3	1891	0·1
1880	2·6	1892	0·3
1881	3·6	1893	0·4
1882	3·6	1894	0·3
1883	2·0	1895	0·08
1884	1·4	1896	0·02
1885	1·4	1897	0·02
1886	0·5	1898	0·04

The first four diagrams relate to countries in which compulsory vaccination has been enforced, namely, England and Wales, Scotland, Sweden, and Prussia. There is a certain similarity in these four curves which show:—

1st.—A relatively high but fluctuating mortality up to 1870.

2ndly.—A sharp rise during the years immediately succeeding, caused by the epidemic which spread over Europe, with the result, already commented on, of a fall to a rate below any previous normal one; and

3rdly.—A mortality rate for the last quarter of a century which, in the light of previous records, may be regarded as insignificant, and which has in fact, in the cases of Scotland, Sweden, and Prussia, become practically extinct.

Austria and Belgium are instances of countries in which compulsory vaccination is not enforced by legislation, and the diagrams (E and F) are instructive. Contrasting Austria (E) with Prussia (D), somewhat similar features are observable up to 1874, the curve for Austria being on the whole slightly the higher of the two. After 1874, however, the curves become very divergent; instead of the practical disappearance shown by the

curve for Prussia, Austrian mortality soon re-assumes its former influence.

The curve for Austria (E) again reaches a high point in 1882, and it is not until 1894 that the mortality falls below 25 per 100,000 living. Since 1891 the vaccination of children has been more sharply supervised, and, by the help of a control (inspection) of the school children, made fairly general. (Ziemlich allgermein durchgefuhrt worden).*

We have hitherto dwelt upon the mortality rates of general populations at aggregated ages in various countries, and shown that the rates among those populations have varied directly according to the stringency of vaccination legislation.

Analysis according to Age-incidence.

The foregoing method, however, by no means exhausts the deductions from the figures, and a different point of view is obtained by an examination of the age-incidence of the mortality.

This has been done for England and Wales by Dr. Newsholme from the figures in the final Report of the Royal Commission; but the following diagrams have been independently drawn and brought up to date from the Registrar-General's Returns.

The diagrams are an analysis of the mortality from small-pox as affecting the population of England and Wales, divided into age-groups.

* Dr. Kubler's Geschichte. Der Pocken und der Impfung.

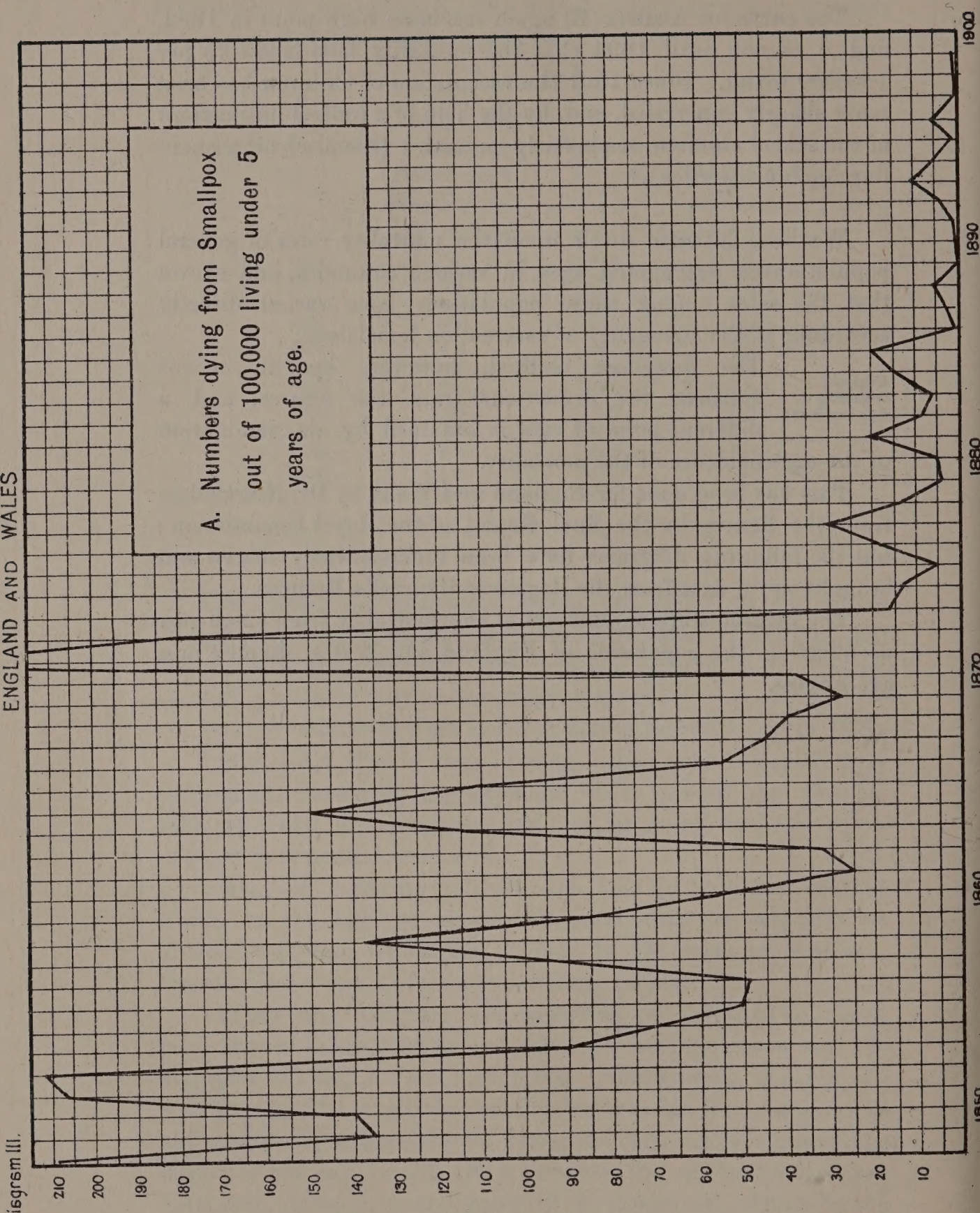
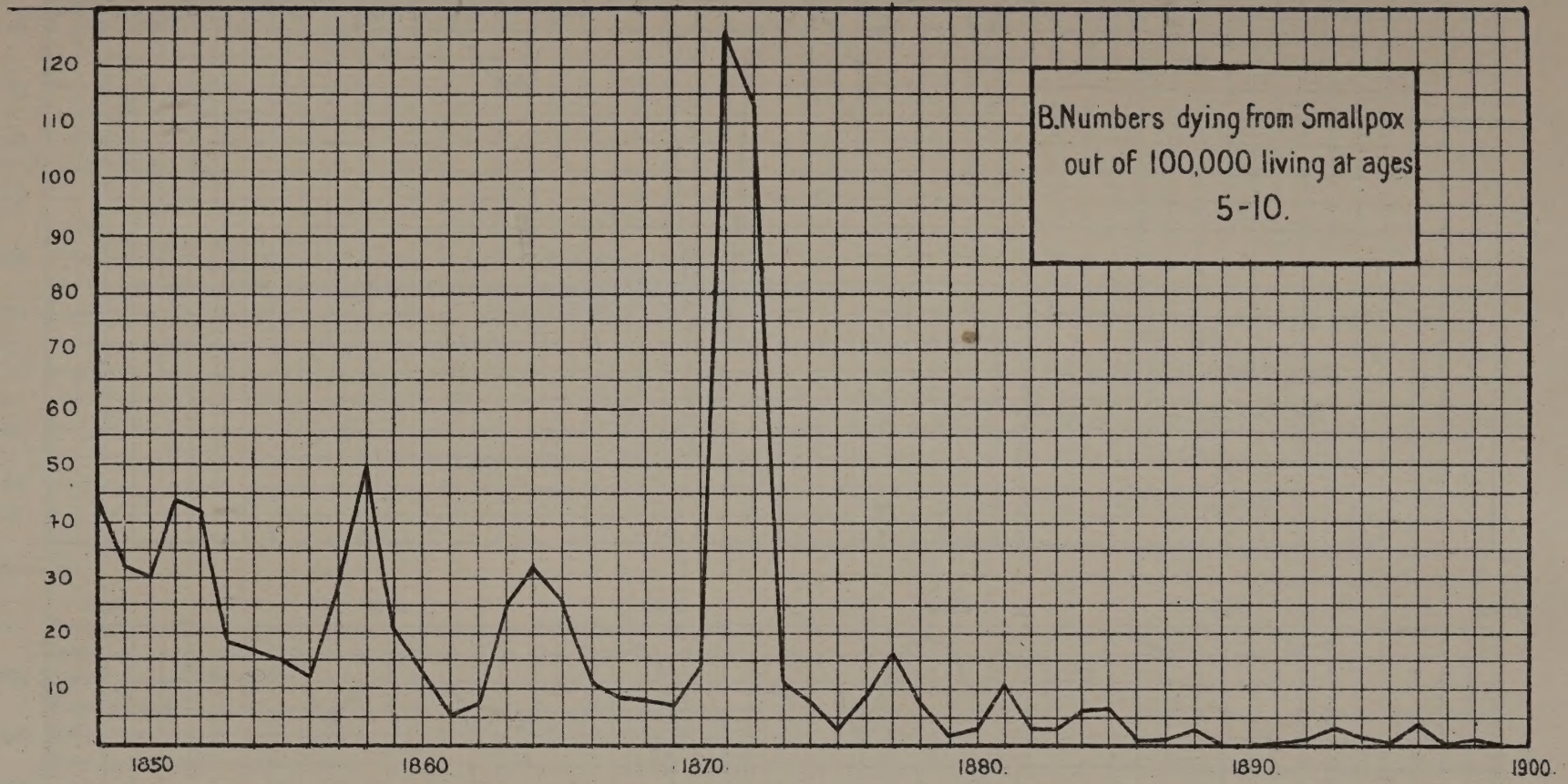

ENGLAND AND WALES
A. Numbers dying from Smallpox out of 100,000 living under 5 years of age.
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
1850
1860
1870
1880
1890
1900

Diagram III.

Diagram III continued



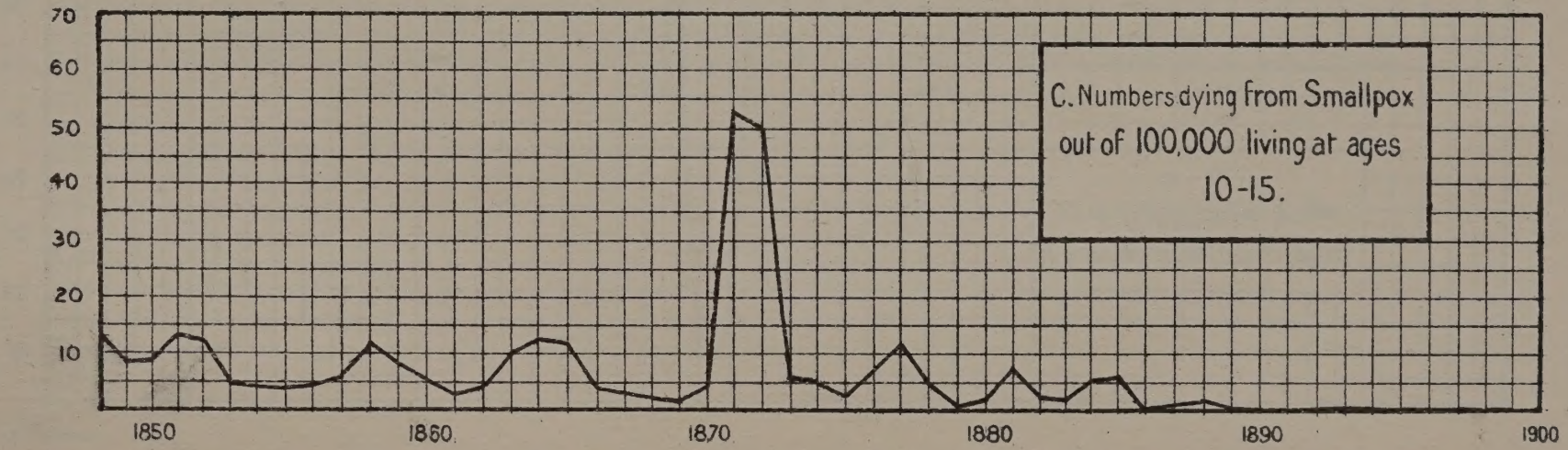
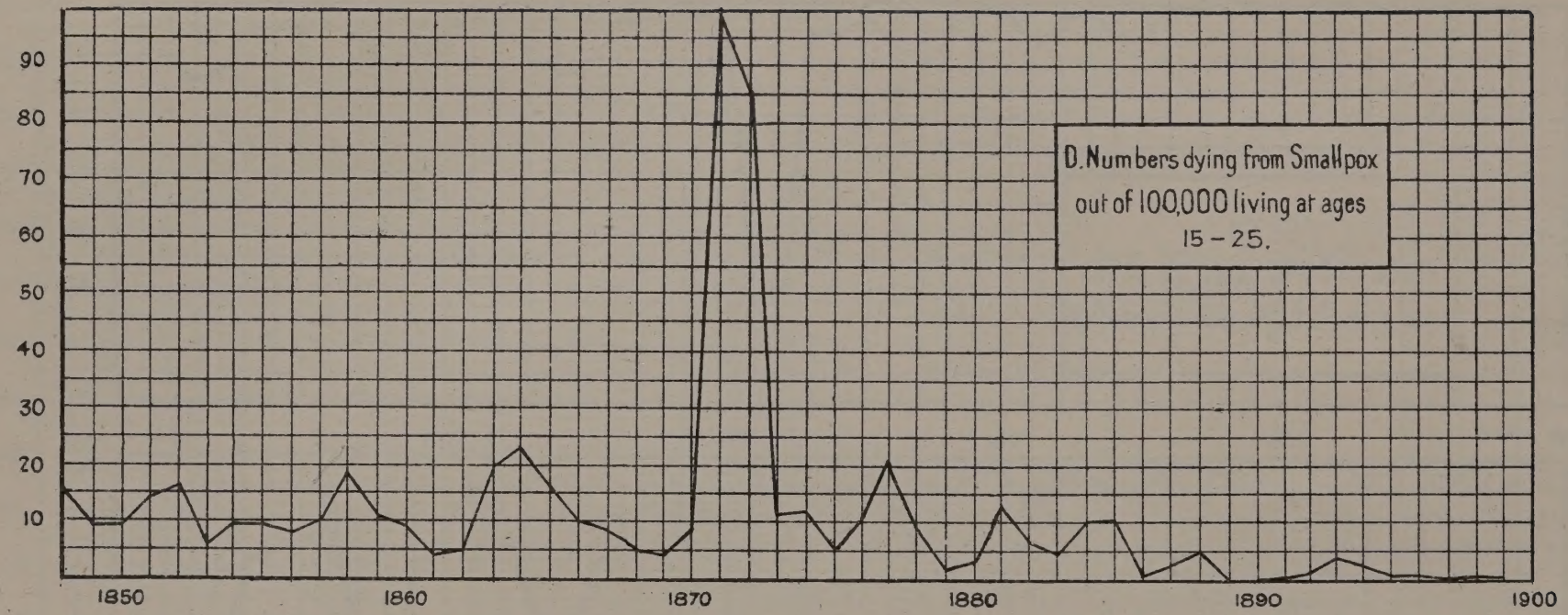


Diagram III. cont^{d}



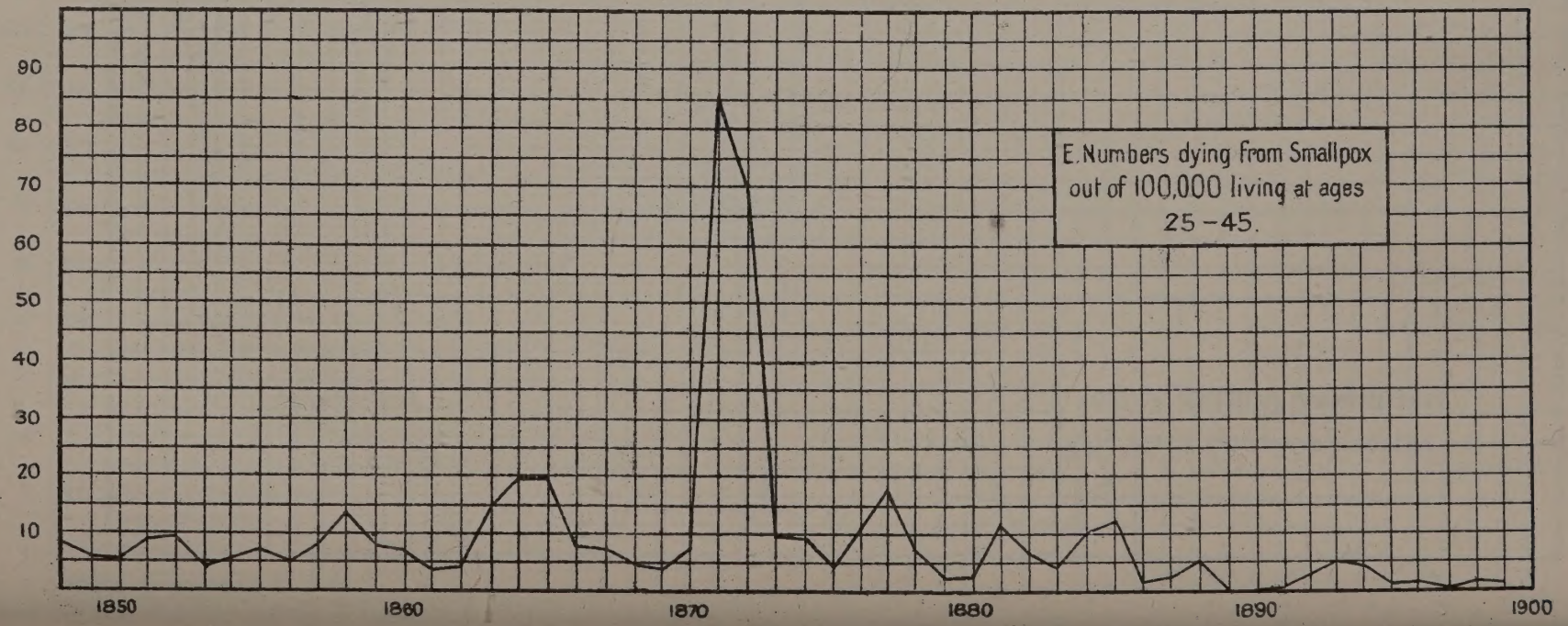
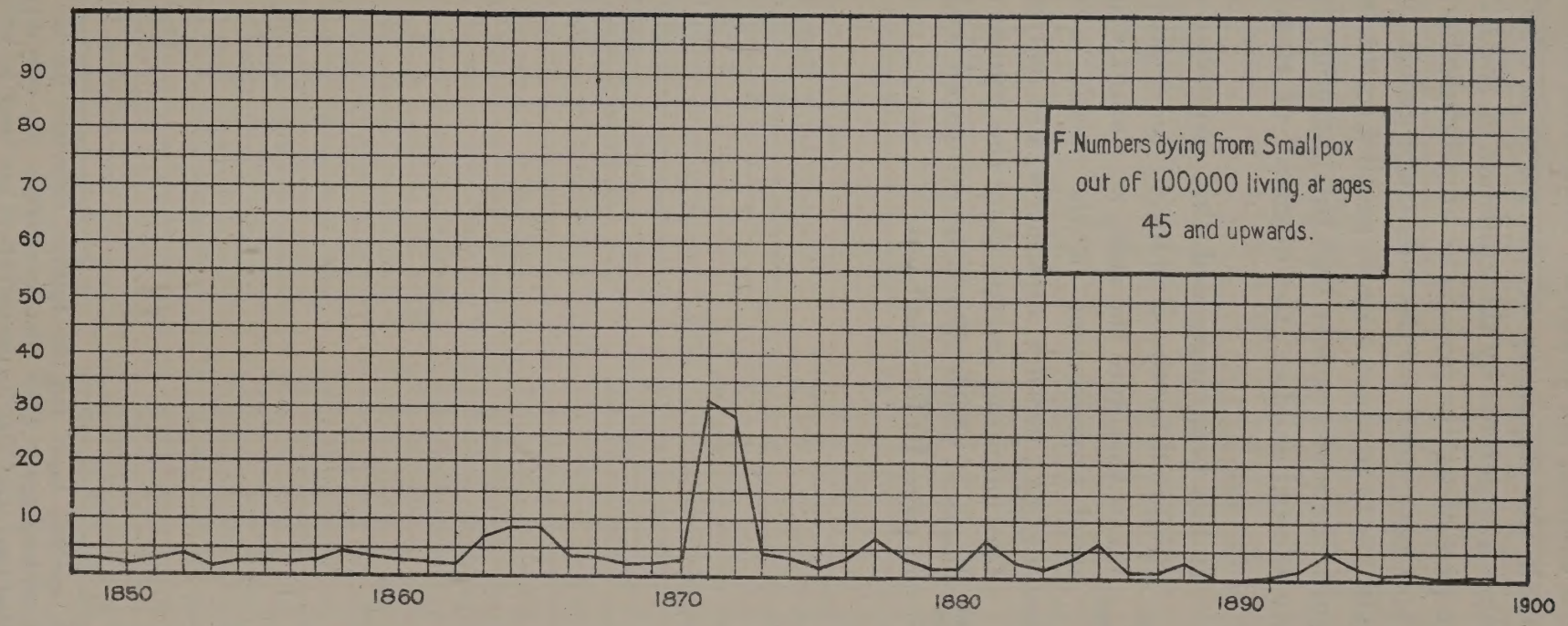


Diagram III. continued.



The curve for the period 0-5 years reproduces, in a more pronounced manner, the downward inclination already commented on, although the regularity of the curve is interrupted in this and all other age-periods by the epidemic of 1870-71.

As we pass along the periods of life, the decline in the curve loses its acuteness, until, for the oldest age-group, the tendency of the mortality is to produce a curve parallel to the base line.

It would, therefore, appear that the immunity from small-pox has mainly affected children, the intensity of such relief varying inversely to the age.*

Improved sanitation does not alone account for immunity from Small-pox.

It has been suggested that improved sanitation has accounted for the diminution in small-pox mortality; but, if this were the case, we should expect to find an equal improvement in the death rates from other febrile diseases, *e.g.*, measles, diphtheria, and scarlet fever.

Trend of Mortality from other Zymotic Diseases.

The following curves show the course of these three diseases, which should be compared with the diagram on page 10 for small-pox.

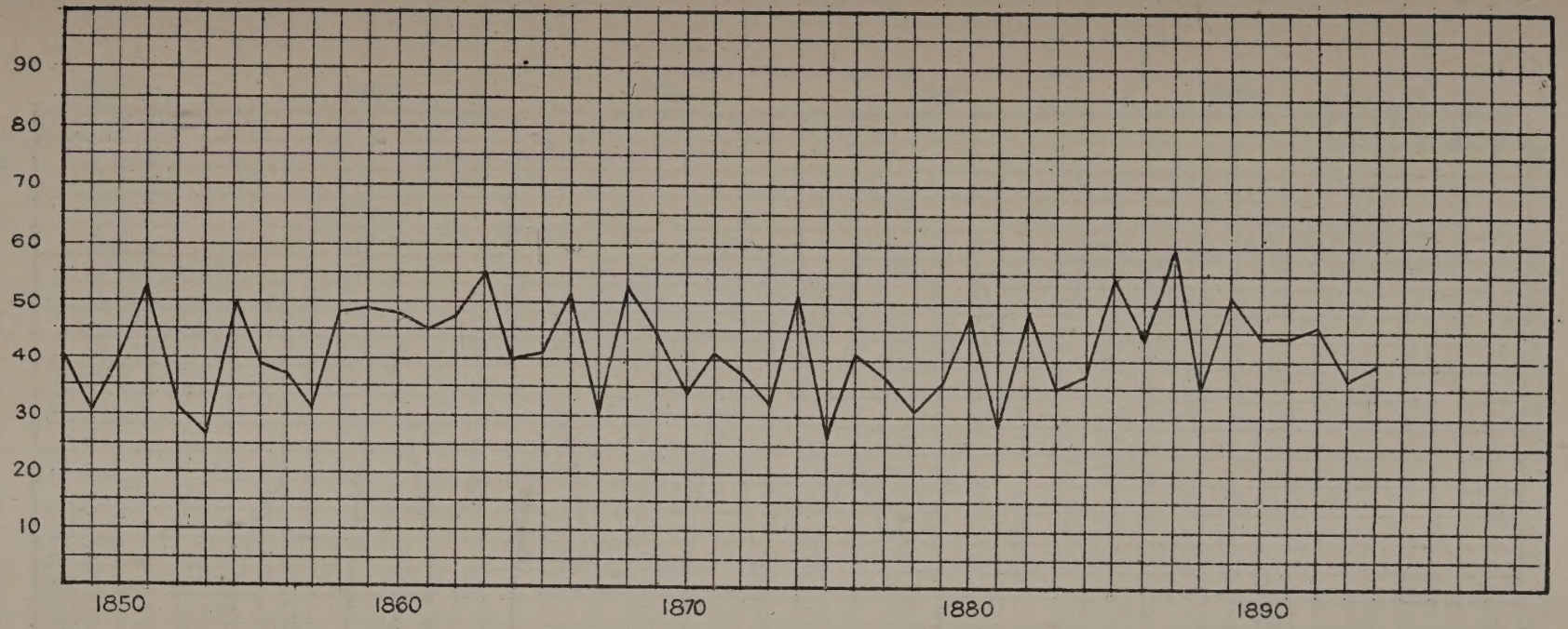
* This analysis bears out the opinion expressed by the late Sir George Buchanan, as long ago as 1888, that vaccination has only a protective influence for a limited time, and that its general effect has been to reduce the number of cases of small-pox in early life.

Diagram IV.

England and Wales.

A

Numbers dying from measles out of 100,000 living at all ages.



B.

Numbers dying from Diphtheria out of 100000 living at all ages.

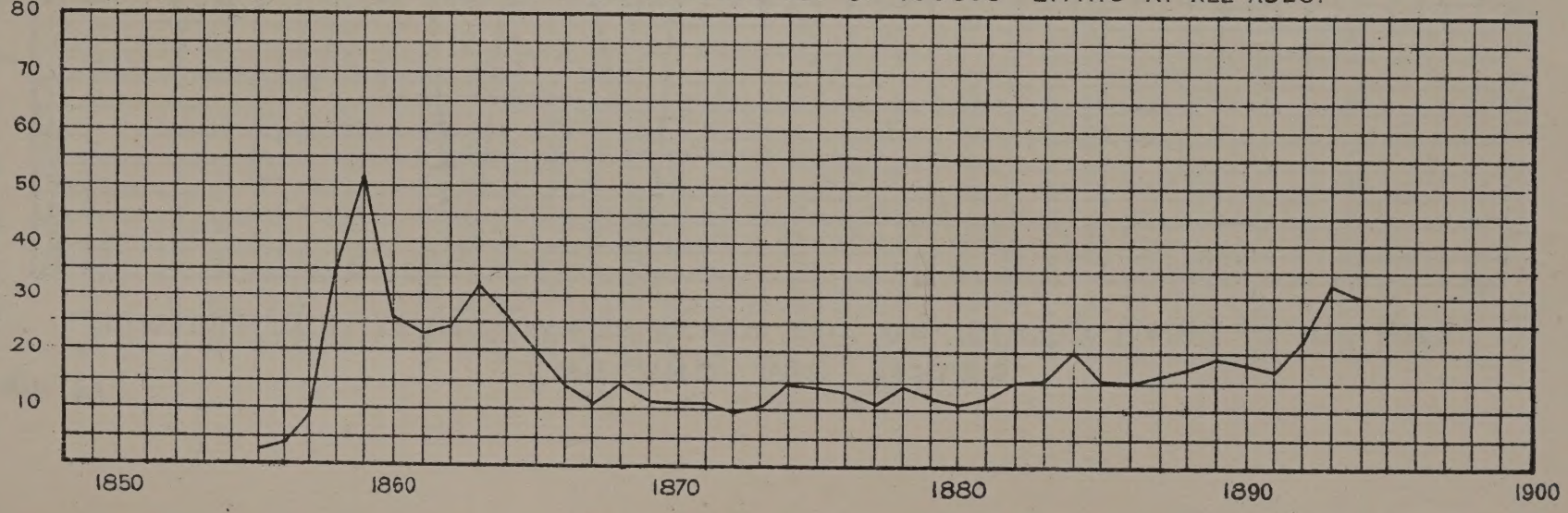
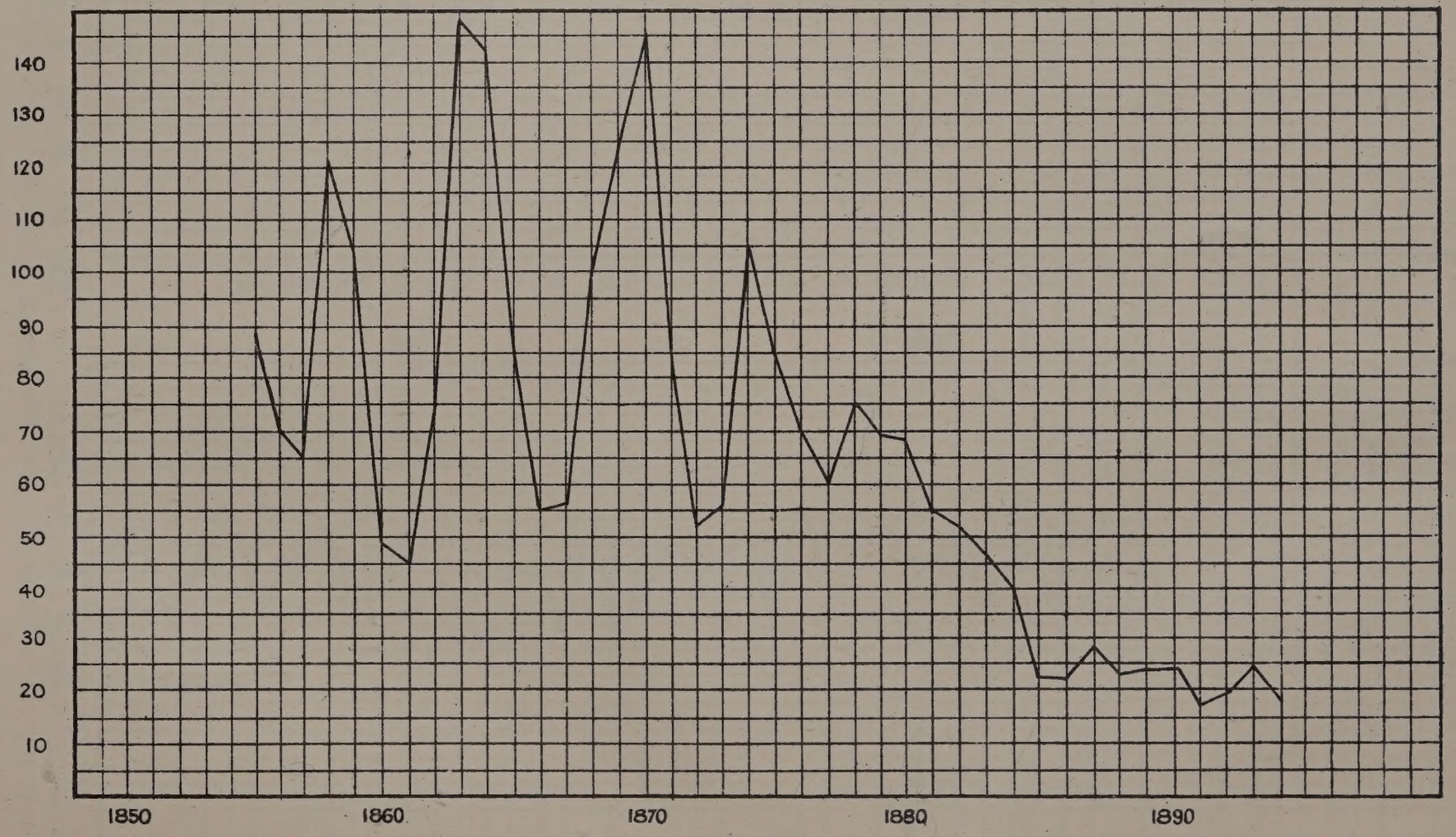


Diagram IV.

England and Wales.

C. Numbers dying from Scarlet Fever out of 100,000 living at all ages.



The figures on which these curves are based are given in the final Report.

This comparison would show that there must be some other cause, in addition to sanitation, which has favourably affected small-pox mortality.

Summary of conclusions to be derived from foregoing analyses.

The conclusions arrived at from the investigation up to the present point may be summarized as follows :—

1. That the mortality from small-pox in the various countries under review would seem to have followed the vaccination legislation, and that a marked difference appears since the epidemic of 1870-74 as between those countries which enforce and those which do not enforce vaccination ; and, further, that in the only example in which re-vaccination is compulsory, namely, Prussia, small-pox has been practically eradicated.
2. As regards England and Wales : The last 50 years may be divided into two periods, namely, the period 1848-70, during which vaccination was compulsory, though not strictly enforced; and the period 1871 onwards, in which vaccination was strictly enforced. The mortality in the first of these periods fluctuated considerably, but showed on the whole a slightly downward inclination. The second period opened with an epidemic, and the figures for 1871-72 were abnormal. The mortality in the following year fell to a low point, thereafter fluctuated within much narrower limits, and remained as a factor of relatively little weight.
3. That the effect of the decline in mortality has principally affected children under 10, the influence being less and less felt as the higher age-groups are reached, until, for ages above 45, the mortality from small-pox remains at the present day as heavy as it was 50 years ago.
4. That sanitary legislation alone does not sufficiently account for the decrease in small-pox mortality.

The next step in the investigation has been an examination into the statistics of special communities and classes in which the vaccination condition is ascertainable.

Sheffield Epidemic.

Of all the epidemics of small-pox, that of Sheffield provides the best means of determining directly the influence exercised by vaccination upon the extent and intensity of the disease; because, for that borough, we have, for the period under review, not only the attacks and mortality among the vaccinated and unvaccinated, respectively, divided into quinquennial age-groups, but, also, —the quite as important factor—the corresponding numbers, vaccinated and unvaccinated, of the population exposed to risk in those age-groups.

To attain this end a "vaccination census" was taken, under the superintendence of Dr. Barry, the Medical Departmental Inspector of the Local Government Board, that is to say, a house-to-house visitation of the borough was made, and particulars obtained for each inmate in the following form:—

Name	Age	Vaccinated	When	Revaccinated	When	Had Small-pox	When

By this means Dr. Barry built up the figures of vaccinated and unvaccinated populations as given in columns (2) and (3) of the following table. In the examination of these results by the Royal Commission, however, it was pointed out that as the Census was taken *during* the Epidemic, a certain number of persons previously unvaccinated would have been vaccinated, and included, therefore, as such in the returns, unduly reducing the unvaccinated "exposed to risk."

Subsequently, therefore, Dr. Barry made the following analysis of the returns of certain streets, with a view to determining the extent to which the true incidence of the exposures had been disturbed, as between the two classes, by the method adopted in making up the returns.

Name of Street	Number of persons returned as vaccinated	Number of persons returned as vaccinated, who had been first vaccinated during the Epidemic
Court 7, Smithfield	17	0
Court 11, Allen Street	44	0
Hollis Croft	346	4
Collier's Row	142	0
Court 1, Rockingham Street . .	31	0
Newcastle Street.	206	3
Court 11, Bailey Street. . . .	30	0
Court 1, Bailey Lane	68	1
Sheldon Street	436	9
	1,320	17

The original returns for the above streets gave 1,320 vaccinated, and 44 unvaccinated; the following analysis shows that a more correct statement of the respective exposures would have been 1,303 vaccinated, and 61 unvaccinated. In other words, the "unvaccinated" should have been larger by 38·6 per-cent (not 28 per-cent, as stated by Dr. Barry, and adopted as a correction by the Royal Commission). In column (5) of the following table, Dr. Barry's "unvaccinated population" (column 3) has been increased by 38·6 per cent, the numbers corresponding to the increase being transferred out of the "vaccinated population" (column 2) ; the adjusted vaccinated population appears in column (4). The remaining columns explain themselves.

Age Periods	Population Enumerated		Population adjusted for Vaccinations during the Epidemic		Cases of Small-pox		Deaths from Small-pox		Attacks per 100,000 Living		Deaths per 100,000 Living	
	Vaccinated	Unvaccinated	Vaccinated	Unvaccinated	Vaccinated	Unvaccinated	Vaccinated	Unvaccinated	Vaccinated	Unvaccinated	Vaccinated	Unvaccinated
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Under 5 years	33,393	1,981	32,628	2,746	121	128	1	66	371	4,661	3·1	2404·5
5 and under 10	34,843	278	34,736	385	232	100	5	34	669	25,974	14·4	8831·2
10 „ 15	32,965	235	32,874	326	629	91	11	32	1,913	27,914	33·5	9816·0
15 „ 20	27,111	282	27,002	391	979	84	19	53	3,626	21,514	70·4	13555·0
20 „ 25	23,795	416	23,634	577	765	76	36	45	3,240	13,173	152·4	7799·0
25 „ 30	20,993	468	20,812	649	502	22	33	16	2,412	3,390	158·6	2467·3
30 „ 35	19,475	319	19,352	442	350	18	28	11	1,810	4,072	144·7	2488·7
35 „ 40	16,626	338	16,495	469	200	13	26	10	1,212	2,772	157·6	2132·2
40 „ 45	15,001	295	14,887	409	153	7	16	3	1,028	1,712	107·5	733·5
45 „ 50	12,017	239	11,925	331	86	7	5	3	721	2,116	42·0	906·3
50 „ 55	9,903	251	9,806	348	58	1	11	...	591	287	112·2	...
55 „ 60	6,432	190	6,359	263	23	1	...	...	362	380	...	...
60 and upwards	12,587	396	12,434	549	29	2	9	1	233	364	72·5	182·1
Age unknown	3,256	27	3,246	37	24	2	...	...	739	...	61·6	...
All Ages	268,397	5,717	266,190	7,922	4,151	552	200	274	1,559	6,968	75·1	3478·7

Diagram V.

SMALLPOX EPIDEMIC AT SHEFFIELD 1887 — 1888.

A { Upper Curve: Rate of Attack from Smallpox among the Unvaccinated per 100,000 living at each Age.
Shaded Portion " " Mortality " " " " " " " " " " "

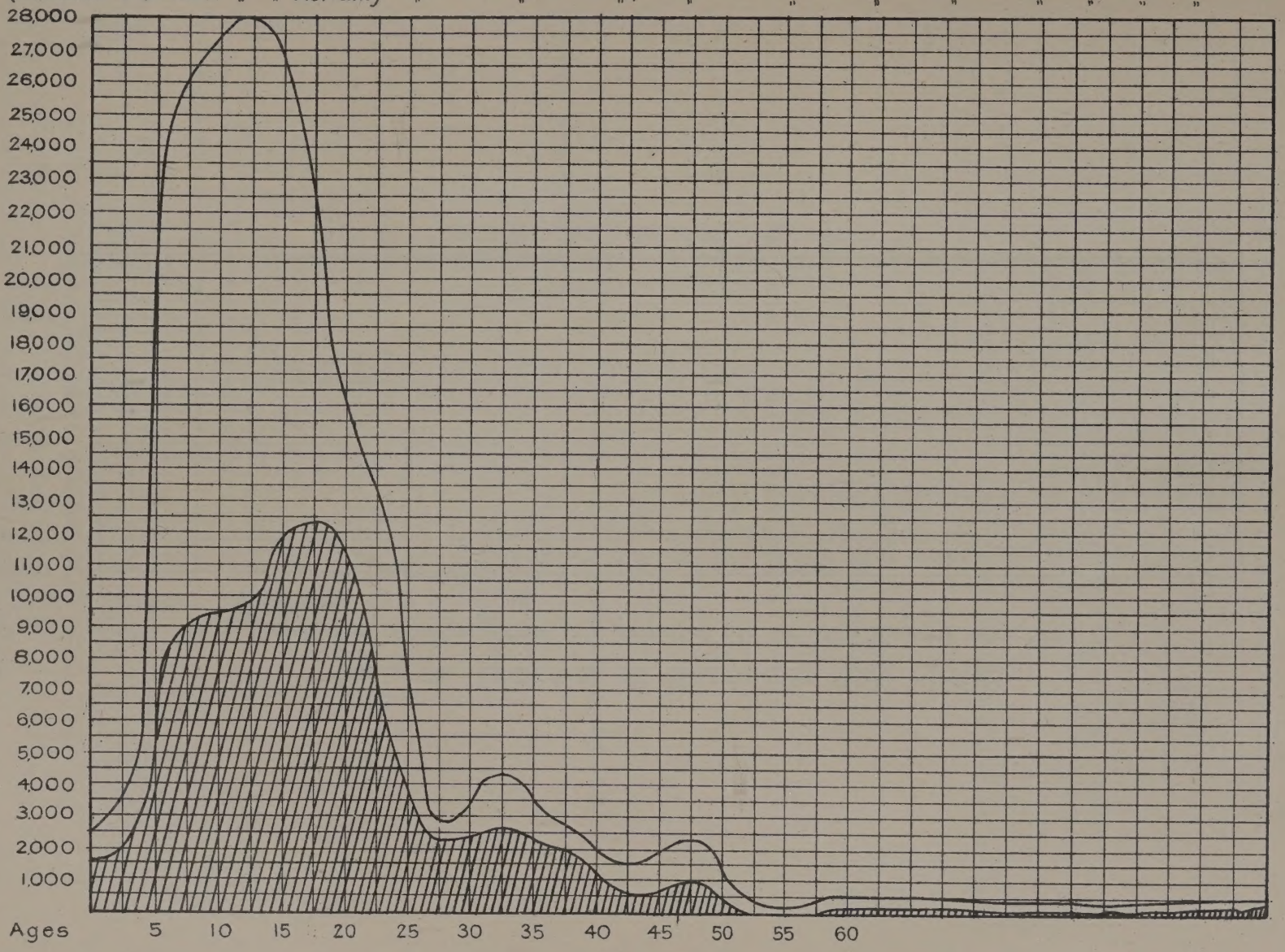
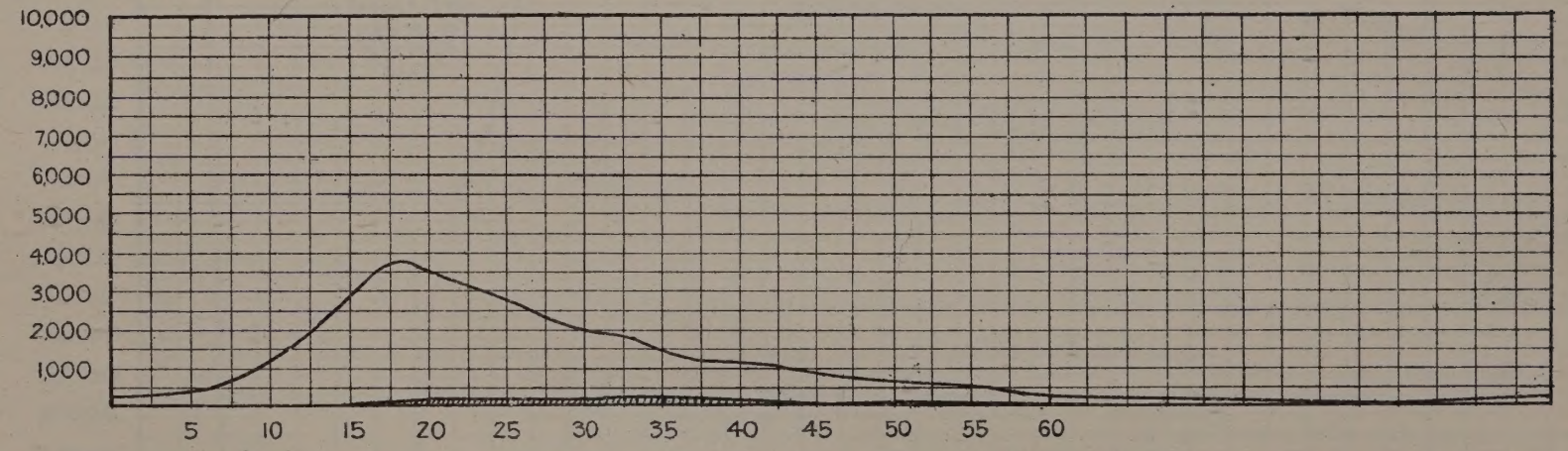


Diagram V continued.

SMALLPOX EPIDEMIC AT SHEFFIELD 1887–1888.

B { Upper Curve: Rate of Attack from Smallpox among the Vaccinated per 100,000, living at each Age.
Shaded Portion: " " Mortality " " " " " " " " " " " "



The most striking features that are brought out by these figures, and by the curves that illustrate them are:—

1. The very large immunity from attack enjoyed by the vaccinated class, as compared with the unvaccinated.
2. The gradual approximation of the rates among the two classes as the groups at the higher ages are reached.
3. The very much smaller percentage of fatal attacks among the vaccinated classes who had contracted the disease than among the unvaccinated.

The following percentages may help to bring out the first two points:—

Ages	Percentages borne by attack rate among Vaccinated to that among Unvaccinated
Under 10 . . .	3·4
10–20 . . .	11·2
20–30 . . .	34·1
30–40 . . .	44·2
40 and upwards . .	60·4

while the third feature is brought into prominence by the following comparison:—

Ages	Percentage of Deaths from Small-pox to number of Attacks.	
	Vaccinated	Unvaccinated
Under 10 . . .	1·7	36·7
10–20 . . .	1·9	47·3
20–30 . . .	5·5	70·0
30–40 . . .	10·0	67·5
40 and upwards . .	11·4	37·5

Further illustrations drawn from Epidemics.

The evidence given by the statistics of those brought under observation only by the fact that they have been attacked by the disease will not alone be entirely satisfactory. The cumulative evidence, however, of records such as the following must carry some weight:

* In Bavaria, in the epidemic of 1871, of 28,081 persons

* Klinger: The Small-pox epidemic of the year 1871, and Vaccination in Bavaria, Nuremberg, 1873.

attacked by small-pox (of whom 906 were under one year of age, 4,128 were aged between 1 and 20, and 23,047 were aged more than 20), 1,251 were known to be unvaccinated, and the rest had been vaccinated.

Of the 26,830 vaccinated, 3,619, or 13·5 per-cent, died.

Of the 1,251 unvaccinated, 752 or 60·1 per-cent, died.

In the Small-pox Hospitals of Berlin, Munster, and Posen, of those attacked by small-pox the percentage of deaths was five times as great among the unvaccinated as among the vaccinated.

* In the district of Oppeln (Silesia), in 1871-1875, of 28,163 vaccinated persons attacked, the deaths were 3,391, or 12 per-cent; of 2,862 unvaccinated persons attacked, the deaths were 1,329, or 46·4 per-cent.

Experience of Armies.

The experience of armies forms the largest available material to be derived from communities of which the individuals are under constant supervision, and whose vaccination condition is a more or less known factor. The armies of Prussia, France, and Austria offer, as communities in which the degree of vaccination has been very different, suitable ground of comparison, both as between one another and at different periods of their own history. In Prussia, general vaccination on entering the Army has been strictly enforced since 1834; in France, although repeatedly ordered, it has only been thoroughly carried out since 1888, and in the Austrian Army there was no vaccination necessary, prior to 1886.

The curves representing the attack and mortality ratios are given in the following diagrams; as, however, in the case of Prussia since 1873, and France and Austria from much more recent dates, the curves approximate closely to the base line,† the actual numerical ratios may, perhaps, provide a better means of comparison, and they are given, therefore, in the subjoined table:—

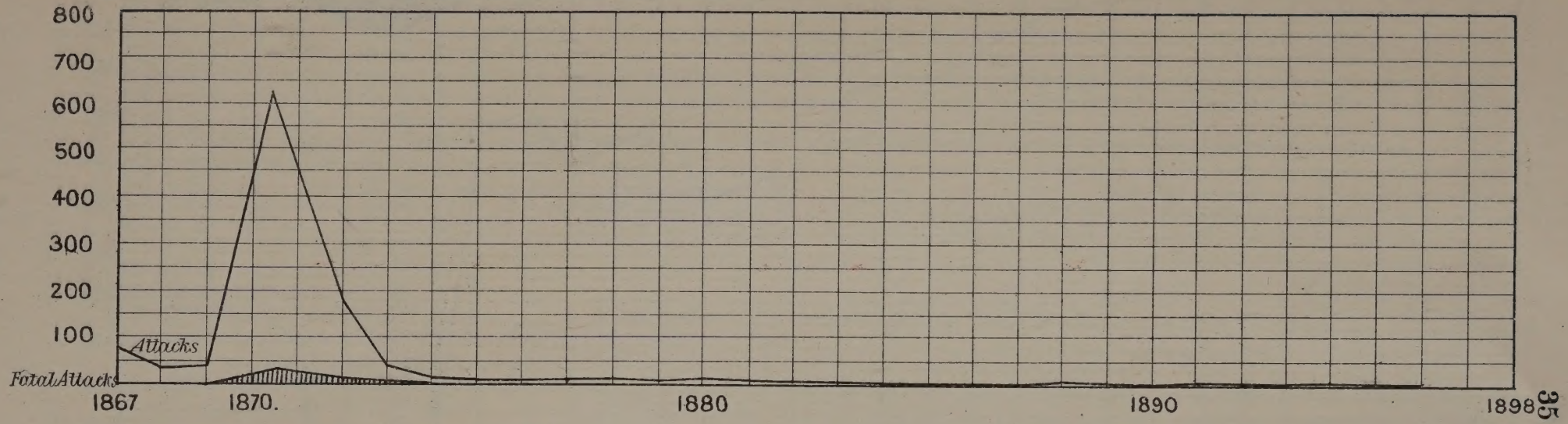
* Pistor: Report on Public Health in Oppeln, for the years 1871-1875. Vaccination in Oppeln, 1876.

† The mortality curve for the Prussian Army, with the exception of the year 1884, in which there was one death from small-pox, has been identical with the base line since 1873.

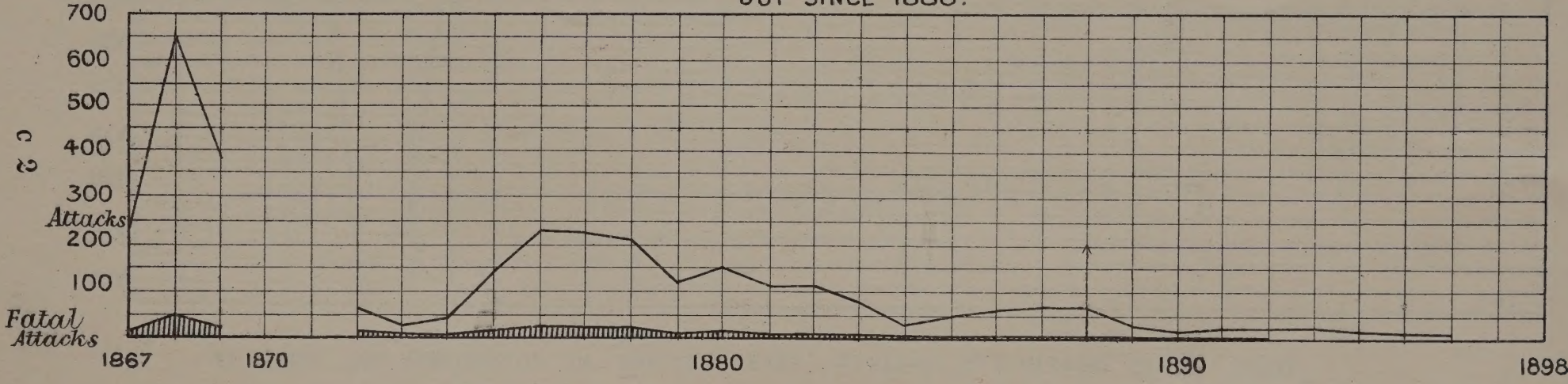
Diagram VI.

ATTACKS AND DEATHS FROM SMALLPOX IN DIFFERENT ARMIES PER 100,000 MEN

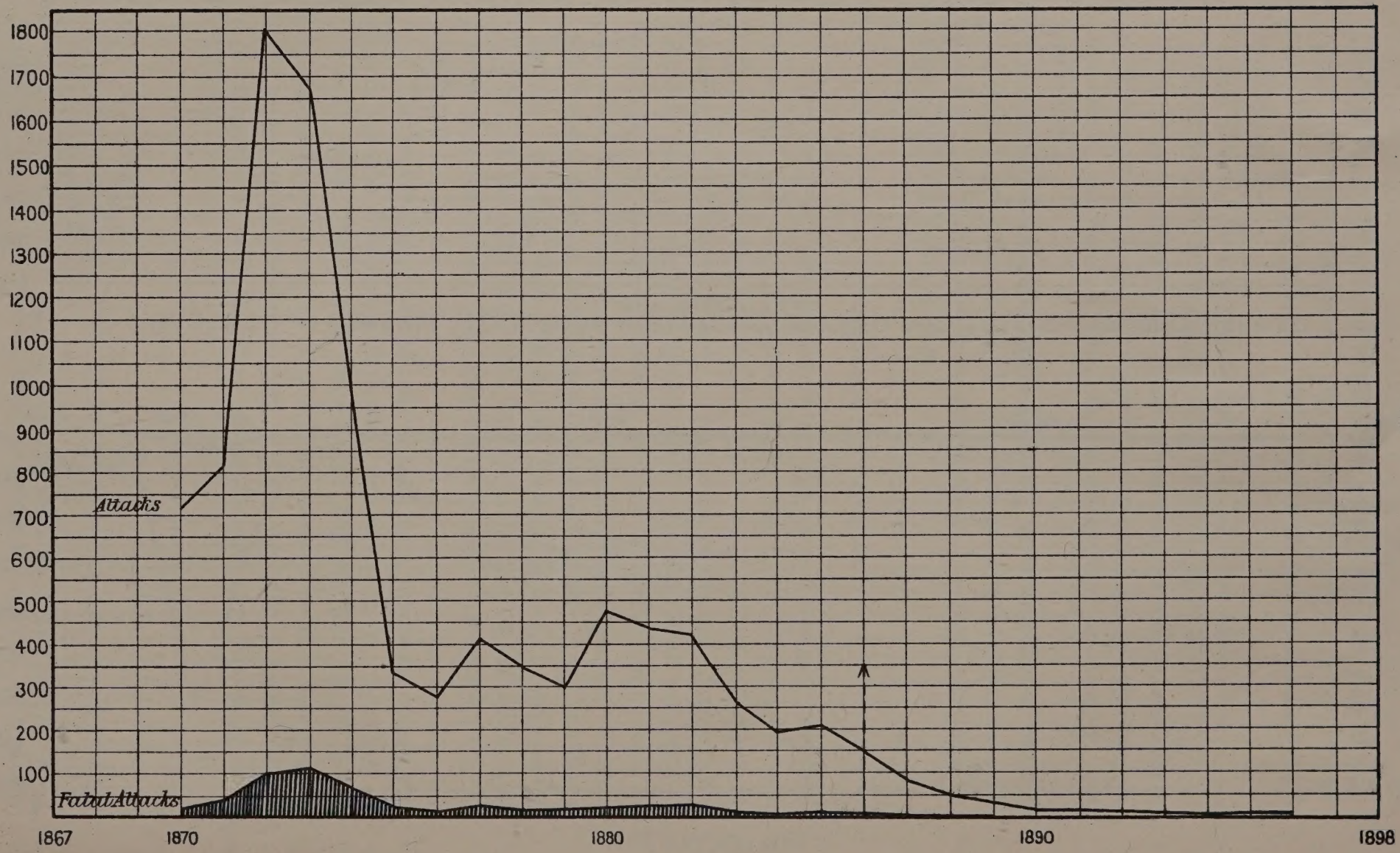
A PRUSSIA: GENERAL VACCINATION SINCE 1834.



B. FRANCE :: GENERAL VACCINATION REPEATEDLY ORDERED, BUT ONLY THOROUGHLY CARRIED OUT SINCE 1888.



C. AUSTRIA NO VACCINATION IN EARLIER YEARS, GENERAL VACCINATION SINCE 1886.



Numbers Attacked by and Dying from Small-pox out of 100,000 *Men.*

Year	Prussian Army		French Army		Austrian Army	
	Attacks	Fatal Attacks	Attacks	Fatal Attacks	Attacks	Fatal Attacks
1867	74·2	0·8	231·1	18·2	...	...
1868	38·7	0·4	650·2	42·8	...	...
1869	43·4	0·4	382·8	22·8	...	...
1870	1260·3	57·8	...	...	718·3	18·5
1871			...	...	815·8	40·1
1872	175·0	5·4	60·0	10·7	1798·4	101·4
1873	41·6	3·0	27·5	4·0	1657·5	108·9
1874	9·6	·0	39·7	3·3	1002·8	66·9
1875	7·0	·0	141·8	17·8	336·5	21·5
1876	6·6	·0	230·5	28·2	274·7	10·4
1877	4·1	·0	222·2	19·6	412·0	25·5
1878	5·6	·0	213·1	20·1	344·0	15·4
1879	2·6	·0	115·6	8·9	303·8	22·7
1880	8·5	·0	153·6	14·9	475·3	25·2
1881	5·5	·0	111·2	7·9	434·2	29·1
1882	6·0	·0	118·8	9·1	423·0	27·7
1883	2·6	·0	81·4	3·3	261·9	16·3
1884	1·8	0·3	36·4	3·3	194·6	7·7
1885	1·8	·0	47·4	1·3	210·6	12·5
1886	1·8	·0	61·1	3·6	140·1	7·9
1887	1·2	·0	68·0	3·9	79·3	3·0
1888	5·2	·0	68·0	2·8	50·4	1·8
1889	1·7	·0	36·2	3·8	34·8	2·1
1890	1·4	·0	18·8	0·8	17·3	0·4
1891	6·2	·0	20·1	0·6	17·9	0·7
1892	5·0	·0	22·3	0·2	15·9	0·0
1893	2·4	·0	25·1	0·8	11·4	0·3
1894	5·3	·0	17·8	1·3	10·1	0·3
1895	2·7	·0	11·2	1·1	10·9	0·7
1896	2·5	·0	9·9	0·5	5·9	0·3

Leaving out of account the years in which the effect of the great epidemic was apparent, and dividing the twenty-two years 1875-1896 inclusive into two periods, the mean annual ratios per 100,000 men are:—

		Period 1875-1885 Inclusive	Period 1886-1896 Inclusive
Prussian Army	Attacks . .	4·7	3·2
	Fatal Attacks	0·0	0·0
French Army	Attacks . .	133·6	32·6
	Fatal Attacks	11·3	1·8
Austrian Army	Attacks . .	333·7	35·8
	Fatal Attacks	19·5	1·6

Or, again, if the six years 1881 to 1886 inclusive be taken, during which vaccination was not carried out to any extent in the French Army, and was not required at all in the Austrian Army, and compared with the six years 1891-1896 inclusive, during which vaccination was compulsory and was strictly enforced in both Armies, it will be seen that, while in the earlier period the rates of attack by small-pox in the French and Austrian Armies were respectively 23 and 85 times as heavy as in the Prussian Army, in the later period the attack rate in the French Army had fallen to four times, and that in the Austrian Army to three times, that of the Prussian Army rate.

Revaccination.

Incidental reference has been made to the protection conferred by revaccination, as in the case of Prussia since 1874, and the Prussian Army since 1834.

The following example of a well-vaccinated community side by side with one not compulsorily vaccinated is given.

In the Prussian Army for the years 1834-1869, the mortality from small-pox was only 40 per-cent of that of the civilian population between ages 15 and 50, the actual ratios being :—

Prussian Army	1·4 per 100,000 men
Civilians (ages 15-50)	3·6 per 100,000 population

Small-pox Hospital Nurses' Experience.

An illustration of the immunity given by revaccination is quoted by Dr. Newsholme from the experience of nurses employed in Small-pox Hospitals.*

". . . . in the experience of the Staff of the Metropolitan Asylums Board Hospitals, in the six years 1890-1895, out of a Staff varying from 1,160 to 2,514, the number who contracted scarlet fever, diphtheria, or typhoid fever during each year varied from 4·0 to 7·3 per-cent of the total staff; while out of a Staff varying from 64 to 320 the percentage attacked by small-pox was nil, except in 1892, when it was 1·4, and in 1893, when it was 1·9."

A further striking example, derived from the present epidemic, of the protection afforded by revaccination is furnished by J. Harley Brooks, M.D., Medical Superintendent of the Mile End Infirmary.

The Nursing Staff on duty at the Mile End Infirmary consisted of 40 nurses and 2 matrons; of these, 29 nurses and the 2 matrons had been revaccinated at periods ranging from 2

* The Elements of Vital Statistics.—Arthur Newsholme, M.D. Lond. Swan, Sonnenschein & Co., Ltd., 1899.

days to 2 years prior to the outbreak in the institution, and four nurses were revaccinated immediately after the outbreak. None of these 35 persons contracted small-pox. The remaining 7 nurses contracted small-pox, and of these 3 had not been revaccinated; the other 4 were revaccinated within the incubation period, as is shown in the following statement:—

	Date of Revaccination.	Date of Removal.
1 nurse	January 24	January 30
1 nurse	January 29	January 31
2 nurses	January 29	February 1

These four were, therefore, virtually not revaccinated.

Deductions from foregoing Results.

We have now examined the evidence, as derived by comparison between countries with and without stringent legislation, respecting vaccination; also between groups of persons at different intervals of time since vaccination. We have, further, investigated the comparative influence of an epidemic upon vaccinated and unvaccinated classes, and, finally, the influence of a stringent revaccination upon communities of which the individuals are under strict observation.

The conclusions arrived at point, irresistibly, to the value of vaccination as an agent in reducing both the rate of attack and the virulence of attack of small-pox. They, also, indicate the necessity of renewing the protection afforded by vaccination in infancy at a later period of life as appearing, for instance, by comparison of the diagrams (Diagram III, A and F), where it is shown that while the mortality in infancy has been reduced to $\frac{1}{40}$th of its former rate, the mortality for ages 45 and upwards has not been diminished.

The virtue of revaccination is shown in the case of Prussia, where, since 1885, not one person in 100,000, and since 1894, not one in a million, has died of small-pox.

III.—Nature and Extent of Vaccination as at present carried out.

Efficient and inefficient Vaccination.

In the foregoing investigation no account has been taken of the character of the operation of vaccination; for, it must be remembered, the mere act of vaccination gives no protection unless it be efficient, and the operation of vaccination has not been legally defined. An examination of the number of marks affords some guide to the

degree of protection, the evidence, upon the whole, pointing to the conclusion that the greater the number of marks the greater the protection. The following figures are derived from an examination of hospital cases.

The percentages for the years 1836-1851 were derived from observations of 3,094 cases of post-vaccinal small-pox, and those for years 1852-1867 from an experience of 10,661 cases.

Cases of Small-pox classified according to the Vaccination Marks borne by each Patient respectively	Percentage dying of Persons attacked 1836—1851	Percentage dying of Persons attacked 1852—1867
Having one vaccination cicatrix . .	7·6	13·8
„ two „ cicatrices. .	4·3	7·7
„ three „ „ . .	1·8	3·0
„ four „ „ . .	·7	·9

Similar results were obtained from the observations of 6,839 cases, as follows :—

No. of Marks	Cases	No. of Deaths	Per-cent
1	1,357	85	6·2
2	1,971	115	5·8
3	1,997	75	3·7
4	1,514	34	2·2

These figures, while illustrating the argument, are not, in my opinion, conclusive, for the reason that the persons classified according to marks may have been differently distributed as to ages; but the consistency between the two sets of figures and the general uniformity of their progression, would be difficult to explain on other grounds than as a result of the degree of vaccination.

If the conclusions up to this point be accepted, namely, the necessity for vaccination universally applied and efficiently carried out, it remains to enquire to what extent the operation of the law has given effect to this requirement.

Degree of Primary Vaccination.

Vaccination, as we have seen, was made compulsory by the Act of 1853, but its universal practice was not strictly enforced until the Act of 1871, when it was rendered obligatory on the part of the Guardians to appoint vaccination officers to enforce the operation of the law.

For many years subsequently to this Act, the number of infants unaccounted for in the year of birth was about 5 per-cent only; the remaining 95 per-cent having either been reported as :—

(*a*) Successfully vaccinated.
(*b*) Insusceptible of vaccination.
(*c*) Having had small-pox.
(*d*) Having died unvaccinated.
or (*e*) Having received certificate of postponement.

Since 1883, however, the percentage of infants unaccounted for has been steadily on the increase, the actual percentages from 1872 to the present time being as follows:—

Children not finally accounted for by Vaccination (including cases postponed), shown as percentages of the Total Births for each year from 1872 *to* 1899.

1872	5·1	1885	5·8
1873	4·8	1886	6·4
1874	4·8	1887	7·1
1875	4·7	1888	8·5
1876	4·3	1889	9·9
1877	4·5	1890	11·3
1878	4·7	1891	13·4
1879	5·0	1892	14·9
1880	4·9	1893	16·1
1881	4·5	1894	19·2
1882	4·8	1895	20·5
1883	5·1	1896	22·9
1884	5·5		

	Percentage excused by Conscientious Objection		Total
1897	3·4	22·7	26·1
1898	5·1	21·5	26·6
1899	3·6	17·2	20·8

It is probable that some portion of the increase may have been due to the fact that the general question of vaccination was under consideration by a Royal Commission during the seven years 1889-1896.

From the births for 1897 onwards, a large number of children have been removed from the column "not finally accounted for", by the fact that certificates of conscientious objection had been obtained in respect of them; for the purpose of deciding the thoroughness of vaccination in each year, these children, however, should be included, and the result appears in the table.

The actual number of children excused by conscientious objection were as follows:—

In respect of the births of 1897	31,687
„ „ 1898	47,423*
„ „ 1899	33,573

* The total amount of certificates of conscientious objection received during 1898 amounted to 203,413. Most of these related to children born and registered before 1898, and were granted under section 2, sub-section 2, of the Act, which gave to all parents with unvaccinated children, no matter when they were born, the option of obtaining certificates of conscientious objection within four months from the passing of the Act.

In Scotland, the corresponding figures of children not finally accounted for from 1864 to the present time, have always been smaller than in England and Wales; the proportion until the year 1898 never having risen to 5 per-cent, the percentage since then having been:—

In respect of births of	1898	5·5 per-cent
„	1899	5·2 „

In fact, there has never been any considerable opposition in Scotland to the practice of vaccination.

The Act of 1898 provides that unless the parent, or other person having the custody of the child, satisfies, within four months from the birth of the child, two justices, or a stipendiary or metropolitan or police magistrate, in petty sessions, that he conscientiously believes that vaccination would be prejudicial to the health of the child, and within seven days thereafter delivers to the vaccination officer for the district a certificate by such justices or magistrate of such conscientious objection, and obtain a certificate of exemption, the child must be vaccinated within six months from the birth; and, as provided under previous Acts, unless the operation be postponed under the certificate of the public vaccinator, the parent, or other person, is liable to be proceeded against summarily.

After allowing for the children excused by conscientious objections, there yet remains a large percentage of children not finally accounted for; and as the administration of the vaccination laws is in the hands of Boards of Guardians, who in many cases have shown themselves to be antagonistic to vaccination, the responsibility for deficient vaccination must be, to some extent, attributed to them.

On this point the Royal Commission reported as follows:—
"We were anxious to learn to what extent the Guardians in "England and Wales had ceased to put the law requiring the "vaccination of children in force. We, accordingly, made "enquiry of the Guardians throughout the country. Answers "were received from 620 out of the 648 unions. We found that "the law was not being enforced in 122 out of these 620 districts; "in 46 out of the 122, however, the Guardians based their action "upon the fact that a Royal Commission had been appointed to "enquire into the subject of vaccination and had not yet "reported."

An indication of the local feeling as regards vaccination is given by the following statement, in which are tabulated the

unions in England and Wales in which, in respect of the births for the year 1899, the cases not finally accounted for are upwards of 20 per-cent.*

Bedford.
Bedford . . . 62·9
Luton . . . 43·4

Berks.
Reading . . . 62·0

Bucks.
Nil.

Cambridge.
Nil.

Chester.
Nil.

Cornwall.
Falmouth . . 31·2
Redruth . . . 29·9
Stratton . . . 23·3
Truro . . . 21·9

Cumberland.
Cockermouth . . 35·2

Derby.
Belper . . . 20·9
Chesterfield . . 28·3
Derby . . . 66·7
Shardlow. . . 32·9

Devon.
Plymouth . . 27·0
Devonport . . 28·7

Dorset.
Weymouth . . 29·3

Durham.
Darlington . . 30·1
Gateshead . . 29·6
South Shields . . 21·8

Essex.
Braintree. . . 20·6
Romford . . . 21·1
West Ham . . 29·7

Gloucester.
Bristol . . . 32·2
Cheltenham . . 23·0
Gloucester . . 34·6
Stroud . . . 27·7
Tewkesbury . . 43·7
Wheatenhurst . . 52·4

Hereford.
Nil.

Herts.
St. Albans . . 29·3
Hemel Hempstead . 26·9

Hunts.
Nil.

Kent.
Gravesend and Milton 35·6
Maidstone . . 22·5

Lancaster.
Burnley . . . 28·7
Chorlton . . . 23·4
Fylde, The . . 20·2
Rochdale. . . 20·7

Leicester.
Ashby-de-la-Zouch. 24·0
Barrow-on-Sour . 33·0
Blaby . . . 27·3
Hinckley. . . 48·4
Leicester . . . 75·2
Loughborough . 22·0
Market Harborough 53·3

Lincoln.
Bourne . . . 23·7

London.
Bethnal Green. . 47·8
Camberwell . . 28·6
George, St., in the East . . . 34·9
Giles, St., and St. George . . 32·3
Hackney . . . 37·7
Holborn . . . 30·8
Islington . . . 28·2
Lambeth . . . 24·0
Lewisham . . 20·6
Marylebone . . 20·2
Mile End Old Town 69·4
Olave, St. . . 22·9
Pancras, St. . . 35·2
Poplar . . . 49·6
Southwark . . 29·6
Shoreditch . . 52·2
Stepney . . . 46·6
Wandsworth and Clapham . . 23·4

Middlesex.
Edmonton . . 27·1

Monmouth.
Nil.

Norfolk.
King's Lynn . . 59·9

Northampton.
Brackley . . . 23·9
Brixworth . . 37·9
Daventry . . 25·0
Kettering . . 62·1
Northampton . . 60·7
Wellingborough . 61·0

Northumberland.
Castle Ward . . 30·2
Morpeth . . . 41·4

Nottingham.
Basford . . . 23·9
Mansfield. . . 32·5
Newark . . . 29·8
Nottingham . . 24·4

Oxford.
Nil.

Rutland.
Nil.

Salop.
Wellington . . 22·9

Somerset.
Axbridge. . . 22·2
Bath . . . 21·5
Bridgwater . . 24·8

Southampton.
Christchurch . . 24·4

Stafford.
Burton-on-Trent . 29·8
Walsall . . . 29·4
W. Bromwich . . 32·3
Wolverhampton . 23·3

Suffolk.
Ipswich . . . 25·7

Surrey.
Croydon . . . 39·4
Kingston. . . 20·9

Sussex.
Brighton . . . 21·3
Eastbourne . . 52·8
E. Grinstead . . 27·5
Lewes . . . 27·0

Warwick.
Atherstone . 36·2
Coventry. . . 30·5
Meriden . . . 24·7
Nuneaton . . 44·9

Westmoreland.
Nil.

Wilts.
Bradford-on-Avon . 44·4
Calne . . . 29·9
Chippenham . . 25·6
Malmesbury . . 21·0
Trowbridge and Melksham 67·3
Westbury . . 30·5

Worcester.
King's Norton . 23·2

York, E. R.
Kingston-upon-Hull 26·6

York, N. R.
Scarborough . . 21·8

York, W. R.
Bradford . . . 24·9
Dewsbury . . 34·8
Halifax . . . 63·1
Keighley . . . 24·8
Skipton . . . 21·0

Anglesey.
Nil.

Brecknock.
Crickhowell . . 22·0

Cardigan.
Nil.

Carmarthen.
Nil.

Carnarvon.
Nil.

Denbigh.
Nil.

Flint.
Nil.

Glamorgan.
Nil.

Merioneth.
Nil.

Montgomery.
Nil.

Pembroke.
Nil.

Radnor.
Rhayader . . 45·7

* The recent decision in the case of Moore *v.* Keyte is of considerable importance. This was an appeal from a conviction by the Magistrates of Leicester, under the Vaccination Acts, the Appellant having been prosecuted by the Vaccination Officer, as such, *against the orders of the Leicester Guardians*, and fined 1*s.* and costs, for neglecting to have his child vaccinated. The Lord Chief Justice, in giving judgment, said that there was no ground for saying that the consent of the Guardians was made a condition precedent to the prosecution. The Vaccination Officer was bound to obey the order of the Local Government Board, and any order of the Guardians, interfering with that order, would not be a legal order that he would be bound to obey.

The aim of the Royal Commissioners was "so to frame "and to administer the law that opposition to vaccination "should not spread to other districts, and that it should cease "or diminish in those parts of the country where it at present "prevails."

The Act which followed was a tentative one. It is operative only until 31 December 1903, and the near approach of its termination raises the important question of future legislation. Possibly, however, the Act may not be modified at the end of its five years, but its operation continued by including it in the schedule of the "Annual Expiring Laws Continuance Act." The working of the Act should, in any event, be thoroughly examined in the near future by another Royal Commission, or by a Departmental Committee, or some other efficient form of enquiry.

It has been shown in the course of this paper that by the means of a thorough primary vaccination, in conjunction with compulsory revaccination at school age and on joining the Army, small-pox may be practically exterminated, and immunity from epidemics given to a community thus protected.

With this example, and with the experience of the present epidemic in London, the nation should, surely, not rest satisfied until primary vaccination shall have become the universal practice and revaccination rendered compulsory.

IV.—Suggestions for Increasing the Popularity of Vaccination and for adding to its Efficiency.

The conscientious objector, as has been shown in the table on page 36, is only responsible for about one-fifth of the infants annually evading vaccination, and, as it is believed that the indulgence conceded by the Act of 1898 removed a certain amount of opposition to the practice of vaccination, it must be assumed as probable that compulsion, with its penalties as existing before the Act, will not be re-introduced.

What, then, are the measures to be taken to secure the vaccination of the 20 per-cent of the children annually born in England and Wales, whose non-vaccination is not accountable for upon any excusable ground, and which, probably, arises, to a large extent, from mere indifference, an indifference

only, as it appears, capable of being overcome in times of epidemic?*

1. It has been suggested that if the control were removed from local authority and placed in the hands of a central body, such as the Local Government Board, the action would be violently resisted, with the result that less, rather than more, vaccination would ensue; but a transfer from guardians to some other local authority, *e.g.*, Borough Urban or Rural District Councils, would not be attended with this objection. Against this latter proposition, however, it is argued that the question, *primâ facie*, is likely to be dealt with from a broader point of view by a body which draws its members from a wider area, than by a body whose members represent a small area, and that as there are only some 640 Boards of Guardians, as against some 1,710 Urban and Rural District Councils, the proposed change would not be the means of better enforced vaccination.† Probably, the question would receive more thorough attention at the hands of County Councils than in the case of either of the bodies above mentioned. This is a matter, however, which has been much discussed, and should receive the careful consideration of any Committee that might be appointed prior to future legislation.
2. The national importance of vaccination would appear to make it a fitting subject for a subsidy, and if an adequate fee were allowed to every medical man, and not only, as at present, to those specially appointed, for each case of successful vaccination performed by him, it is probable that there would be a large

* I have no means of estimating the numbers that have been vaccinated or revaccinated during the present epidemic. Our local papers, in February 1902, mentioned the "rush" to be vaccinated; the people outside the house of the public vaccinator being on some evenings of such proportions as to put one in mind of the pit crowds outside some of the more popular London theatres.

† The present feeling, on the question of vaccination, obtaining among the various Urban District Councils throughout the country is shown in the response obtained by the Beckenham Council to their circular asking for resolutions in favour of a repeal of the Conscientious Objector Clauses of the Vaccination Act of 1898. As a result, 94 Councils passed similar resolutions, 46 decided to take no action, 73 sent a formal acknowledgment, and 936 made no reply.

extension of the practice. This would, no doubt, entail an inspection of results by Government officials, and it should be an object of an enquiry whether the consequent expense could reasonably be undertaken by the Government.

3. The operation of vaccination has never been defined by the Legislature, and any future Act should contain a statement of the maximum number and area of cicatrices.

4. Hitherto, lymph from the Government vaccine establishment has only been supplied to Government vaccinators, but it would seem advisable that all medical men should be able to obtain it. If, in the present position of the Government laboratories, the output would be insufficient to meet such a demand, this department should be enlarged sufficiently to enable the very general desire to obtain lymph guaranteed by the Government to be complied with. Such lymph need not, necessarily, be supplied gratis, but might be sold at the same cost as that produced from trade sources.

It would be undesirable to discourage, entirely, the manufacture of lymph by private enterprise, because the demand is occasionally, as in times of epidemics, excessive and greater than the Government might be able to meet, having regard to the fact that the lymph, as pointed out by Dr. Monckton Copeman, retains full activity for only a limited period. But, as the preparation and testing of glycerinated calf lymph is a matter requiring great skill and care, it should be necessary that the lymph manufactured by private persons should be either under the supervision of, or be bacteriologically* tested by, Government officials. This would prevent the possibility of inert lymph being supplied to medical men, of which instances have recently been given in the Medical Press.†

The processes employed in the purification and preservation of Government lymph, for which

* If practicable, a clinical test, also, would be advisable.

† *British Medical Journal*, 2 November 1901, page 1380.

Dr. Monckton Copeman is responsible, have been described by him at length in his Milroy Lectures, delivered before the Royal College of Physicians in 1898, and, more recently, in an address to the Royal Medical and Chirurgical Society in December 1901.

5. The future Act should include the enforcement of revaccination, for which, as is shown in the instance of Germany, the school age would offer the suitable opportunity.

APPENDIX.

Practice of British Life Assurance Offices.

For the purpose of this paper information was collected as to the present practice of Life Assurance Offices with regard to the question of vaccination.

The replies of the Offices may be summarized as follows;—

Practice as regards Enquiries made to Proposer.

60 enquire "Has the life been vaccinated?"
8 enquire date of last vaccination.
1 enquires now, "Has the life been vaccinated?" but intends to ask date of last vaccination in future.
2 do not make any enquiry *re* vaccination.

71

1 Office charges an extra premium if the life has not been revaccinated.

23 charge extra. Extra varying from 2*s.* 6*d.* per-cent to 10*s.* per-cent, or life rated up from two to ten years.
13 insert condition, declaring policy to be null and void in the event of death from variola.
3 insert condition, returning only surrender-value in the event of death from variola.
9 charge extra, or insert condition declaring policy to be null and void in the event of death from variola.
1 charges extra, or inserts condition returning only surrender-value in the event of death from variola.
5 charge extra, or insert condition returning only premiums paid in the event of death from variola.
11 decline case if unvaccinated.
1 has no fixed practice.

73

None of the nine Industrial Offices, who furnished information, make any enquiry or charge an extra premium.

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2 do not make any enquiry *re* vaccination.

71

Practice of Office where the Life proposed is Unvaccinated.

7 do not make any extra charge.
23 charge extra. Extra varying from 2*s.* 6*d.* per-cent to 10*s.* per-cent, or life rated up from two to ten years.
13 insert condition, declaring policy to be null and void in the event of death from variola.
3 insert condition, returning only surrender-value in the event of death from variola.
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1 charges extra, or inserts condition returning only surrender-value in the event of death from variola.
5 charge extra, or insert condition returning only premiums paid in the event of death from variola.
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1 has no fixed practice.

73

None of the nine Industrial Offices, who furnished information, make any enquiry or charge an extra premium.

Practice of American Offices.

It was a somewhat general custom in America, up to a recent date, to require either evidence of vaccination within a reasonable period, or revaccination, in default of which a clause would be inserted relieving the Office of liability in case of death from small-pox.

The larger Companies have, apparently, discontinued action of this kind, in view of the general custom of vaccination, and the, consequently, slight danger of small-pox even among unvaccinated persons.

Mr. Emory McClintock writes :—

"The impression prevails among our medical men that deaths from small-pox among those who hold policies not carrying that risk are very rare, they being only a small fraction of a community in which there are but few deaths from that disease. The health authorities of the several States have broad powers, and when small-pox shows itself require vaccination in the locality. Your 'conscience clause' would not be approved here."

Sir Henry M. Stanley, G.C.B., contributes some interesting facts as the result of his experience among the natives employed in his African Expeditions.

2, Richmond Terrace,
Whitehall, S.W.
20 *November* 1901.

Dear Sir,

My faith in vaccination has been confirmed by my experiences in five African expeditions.

In 1871-72, I was too inexperienced in African travel to provide against the pest of small-pox, which generally decimated native caravans. As a result, I lost 23 men out of 196 by small-pox.

In 1874-77, I had over 350 men. I had them all vaccinated before starting. The loss by small-pox during three years was five men.

In 1879-84 my first contingent numbered 68 men. They were all vaccinated by myself. During the three years I lost none. Second contingent of 250 men were also vaccinated. There was no loss from small-pox during their term of service. Third contingent of 226 men, brought by Lieutenant Valcke, were not vaccinated, and when they reached the Cape from Zanzibar, the ship they were in was put in quarantine while at Cape Town. When she reached the Congo a month later, 22 men had died, and over 50 were on the sick list from the disease. The worst feature connected with this contingent was that only 79 men were ever reported fit for duty.

In 1887-89, 620 men and boys belonged to this expedition. During the first year there was no case of variola in the expedition.

In the second year, 130 were detached for separate duty, in doing which they became mixed up with a body of over 330 natives, a few of whom had already been attacked with small-pox.

Compelled to travel together for nearly 600 miles, through a hostile country, there were no means of isolating those afflicted from the other people. At the muster made 22 December 1888, it was found the journey's casualties were 106, of whom nearly one-fifth had died from small-pox.

Out of the 620 vaccinated in February 1887, one had become delirious from a confluent case of small-pox, and committed suicide by jumping into a cataract. Two had slightly contracted the disease, and for a week were relieved from duty. At the end of that week they resumed their place in the marching column, and appeared none the worse.

Yours faithfully,

HENRY M. STANLEY.

A. F. Burridge, Esq.

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